McGRAW-HILL
PUBLISHING COMPANY, INC.
JAMES H. McGRAW, *President*
MASON BRITTON, *Vice-President*

American Machinist

Editors
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Volume 68 | New York, March 1, 1928 | Number 9

Handling Large Production in Metal Stamping

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Large-scale production of sheet-metal parts invariably requires rapid movement of work in process, and quick turnover of material—How one company controls its press department

PROBABLY in no other part of a large manufacturing plant is work required to move faster, or in greater volume of individual jobs, than in the metal-stamping department. Where this volume of work requires the handling of a stock totaling about 12,000,000 lb. of sheet metal on hand at all times, and a complete turnover of this stock once every six to eight weeks, a positive control of all jobs in process is a vital necessity. In the metal-stamping department of the Westinghouse Electric and Manufacturing Company, 20,000 separate items are in process of manufacture every month, the average length of time that a job is in process being about twelve days. For the making of these parts, there is an inventory of 40,000 dies, a large part of which must be kept instantly available. For handling the work of the metal-stamping department at the present time, there is a force of 800 employees, of which 284 men are employed on die making. The ratio of so-called non-productive labor, and of material, in a metal stamping department of this kind, therefore, are much higher than the plant average, and must be offset by the rapidity of handling the work in production.

For any plant production job requiring press-work parts in the assembly, the engineering department sends a copy of the specification sheet to the metal stamping department. Upon receipt of this engineering information, based on the general order for the complete machine, a clerk in the metal-stamping department prepares a hectograph form of requisitions on the shop for the sheet metal parts. This requisition form is shown in Fig. 1. It contains the schedule date when the finished material is wanted, and information in regard to the drawing number, tools and dies necessary, and the amount and nature of the raw material. If a new die is required for the job, a separate order must be made out on the tool-making section, and a date of tool completion given

A. B. REQUISITION		DATE WANTED
S. O. PAGE DRAWING	SUB.	
STYLE ITEM	PATTERN	
QUANTITY TOOLS	ROUTING & GROUP	
DESCRIPTION & MATERIAL		
DELIVER TO PROC. SPEC. OR FINISH NO.	FINISHED WEIGHT	
DATE SHIPPED	INSPECTOR'S SIGNATURE	
TOTAL TIME ALLOWANCE	COST DATA PRICE PER—	
ADDITIONAL INFORMATION	VALUE	
DATE WRITTEN		

Fig. 1—Requisition for press work.

MATERIAL DELIVERED — Form 13708 W. E. & M. Co. WORKS DEPT.

DATE	DELIVERED	TOTAL DELIVERED	DATE	DELIVERED	TOTAL DELIVERED	DATE	DELIVERED	TOTAL DELIVERED

Printed in U.S.A.

Fig. 2—Shipment record on office copy

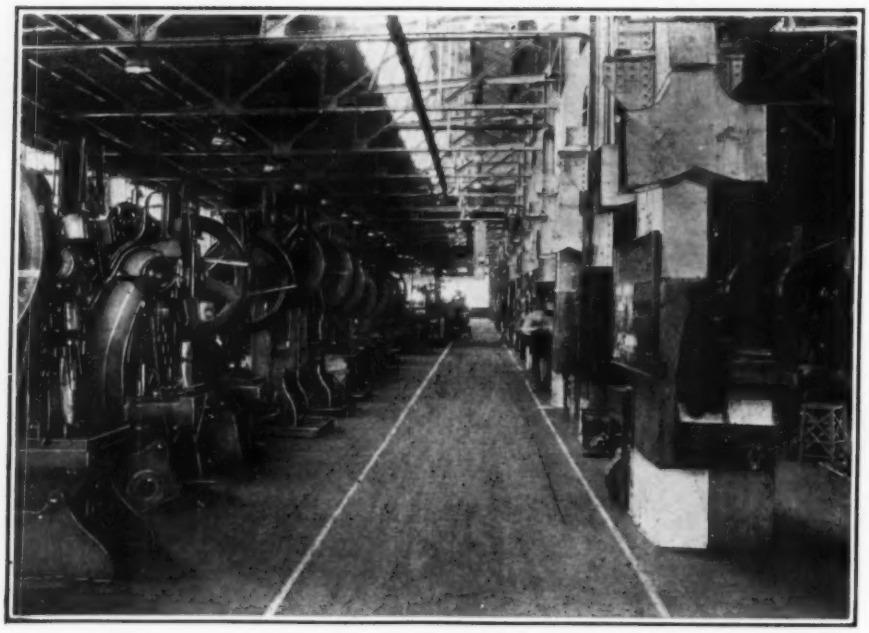


Fig. 3—A view in one of the press rooms. Aisles are kept well defined for proper piling of material and parts, machines are grouped according to class of work, moving parts are protected by guards, and overhead shafting is eliminated, giving ample light to the tools

Die No. _____ Rack _____ Shelf No. _____

Remarks _____

Out	Dept.	In	Out	Dept.	In

Fig. 4—Die storage record card

that will fit in with the schedule for the part. A staff of tool designers is maintained in the metal-stamping department, apart from the general engineering department of the plant.

The hectograph form of the requisition is immediately run off on a duplicating machine by a transcribing clerk, making eight copies for distribution to the various production divisions interested. These copies are on various colored cards, and are distributed as follows: The white copy is used for office information, and is the one from which shipments are made, the reverse having spaces for shipment entries, as shown in Fig. 2; the buff colored copy goes to the group leader handling the job in the shop; the white linen copy has a cord attached, and is tied to the material for identification during process. This copy is finally signed by the inspector for quality; the salmon colored copy serves as a requisition for securing blueprints and other engineering material necessary; the plain white copy goes to the workman, and is used as an advice to the timekeeper of the completion of the work; the green copy is used as a date tickler in the shop to remind the foreman that the particular item is due on a specific date. When the item is completed, this copy is forwarded to the accounting department, which uses it for billing purposes; the pink copy is used only when materials must pass through an annealing or enameling process, and is employed in these departments; the golden-rod copy is attached to the linen identification copy, and sent with the material to the assembly department. Upon receipt of the material in the assembly room, this copy is forwarded to the accounting department as a check copy against the billing. The press rooms of the metal stamping department, such as shown in Fig. 3, are divided into groups, headed by group leaders, who are in reality sub-foremen, and handle all the production jobs assigned to their groups. This includes drawing of the necessary material stocks, sending to the storeroom for dies, filling the required requisitions and replacement of the dies to the storeroom. With the requisition, they are provided with the necessary blueprints, and the process of raw materials requisitioned has already been initiated with the distribution of the white linen copy of the requisition form. To cover the routing of the dies and tools necessary for any job, the group leader lists the tools required, which list is given to a clerk handling die storage records. The die storage clerk keeps a tool-record card, shown in Fig. 4. One of these cards is kept for each tool, and about 40,000 dies and tools are active at all times. On the card a record is kept every time the tool is given out and returned. From the group leader's list the clerk makes out in duplicate the die-wanted form, shown in Fig. 5, giving location and routing of the die. One copy of this card is hung on a board in the die storage room, and a group of die handlers, paid on an incentive basis, secures these tools and delivers them to the proper destination. The duplicate copy is used as a checker against the actual delivery of all these tools. The die-wanted card accompanies the tool, and is used to relocate the tools in their proper place when they are returned. By keeping the in and out records on the record card, the location of the tool is always known, and also it makes it possible to judge at once what tools should be placed in the inactive storage. A record is maintained on the part drawing showing the amount of material necessary for a job, as well as the most economical manner in which to cut the material. The total amount of material for a given order can thus be figured, and the salmon colored copy of the requisition is routed to the shearing group, which cuts up the material and delivers it to the groups designated on the order. When the dies are set up and the first piece is made, an inspector is called who passes on the quality. The green file copy gives the foreman an inventory of work ahead.

Form 5946-B
W. E. & M. Co.
Works Dept.

Die No......

WANTED

Rack.....**Shelf No.**.....

Dept......

Group.....

Date.....

Location on Truck.....

Remarks.....

.....

Printed in U. S. A.

Fig. 5—Sub requisition for dies from storage

The Privileged Class

AN OPPRESSIVE silence hung over the little group in the works manager's office. Frank Hayward, chief engineer of the Judson plant of the big Atlas Corporation, had just left a conference that had proved to be rather stormy. William Holland, unofficial consultant, was sitting in, at the works manager's request.

The subject under discussion had been a large order for partly special locks that had barely missed cancellation for failure to meet the promised delivery date. Thomas Vaughn, the works manager, at the request of Bill Holland had called in his chief engineer, his superintendent, Carl Weber, the production chief, Arthur Wales, and the master mechanic, Harry Atha, to sift the matter from top to bottom and insure, if possible, against a repetition. It was one of Mr. Holland's hobbies to say as little as possible about past mistakes and concentrate on preventing recurrences.

"I'm sorry Frank had to leave before we got this thing finally thrashed out," said Vaughn. "So far as I can see, there have been minor delays all along the line. The sales department wasted two days verifying an item by letter that they might have settled by 'phone or wire. The production department was a little slow getting the order into the works but not enough to worry about. Harry," turning to the master mechanic, "is the equipment in good shape in the departments that handled that order?"

"Yes, sir," replied Atha, "I'm sorry to say it is. If it wasn't I'd have a fine chance to come at you to buy some new machines. As it happens, those departments have just been overhauled and there isn't much but new stuff in them."

"That's right, Tom," broke in the superintendent. "If the equipment hadn't been right we never would have got that order through when we did. We did some sinful overloading and overspeeding."

"What about materials?" broke in Holland. "Was there any delay there?"

"Yes," replied Weber. "We expected to hear from the engineering department on Tuesday so that we could get in what we needed by Thursday. You know we are getting wonderful freight service now. What used to take a week, or sometimes two, now gets in the next day, or the day after. But we didn't hear from them until Friday, which meant that although we got out our orders as fast as we could the week-end lull held us up until Tuesday—five days later. And those five days looked awful big to the department foremen, for they had to make them up out of an allowance that wasn't generous to begin with."

"Um," observed Mr. Holland. "A light begins to dawn. I wish Hayward could have stayed a little longer. What's the trouble, Mr. Wales, you look as though you had something on your chest."

"I have," returned the production man. "And although Frank isn't here I'm going to get it off. I wish he had stayed so that he could hear what I'm going to say. I like him and I think he's a darned good engineer, and conscientious. But his department gets my goat."

Wales had held in as long as he could but now he boiled over.

"Why, those gosh-hanged, high-brow engineers in his department think they can take as long as they blame well please to get a rush order through. Talk about your privileged classes! Those birds are shut off from the noise and dirt of the factory in their nice, light office and they think that regulations don't apply to them. Why shouldn't their work be planned ahead just as the production work is? You don't catch foremen putting off the hard jobs to do some easier, pleasanter one.

"I believe some of those ducks think they have temperament! Believe me, there isn't any room for temperament when things get in a jam in the shop. And there wouldn't be so many jams if the engineers lived up to their schedules so that the foremen had half a chance to take time to do a job right. Honest, I'm ashamed to go to the foremen and ask them to rush any more jobs through in half the time they ought to take, just to make up for procrastination somewhere else. I've done it too often."

Again the silence lasted until the air seemed electric, but this time there was a difference. The cat was out of the bag and everyone felt better, even as he wondered what would happen next. Holland

was smiling confidentially at the ceiling and humming softly to himself.

Finally the works manager, who had been looking thoughtfully out of the window, brought his chair to the vertical and leaned forward on his table, a sure sign that he had made up his mind. "Art, I think you've hit it, but I want to be sure before we take any action. I'm glad you spoke out but I wish you had done it sooner. Carl, get Hayward to have lunch with us two tomorrow, and let's see if we can't help him to systematize his department. You'll sit in with us, won't you, Mr. Holland? That's all tonight, boys. This has been one conference that wasn't a waste of time.

Executives are invited to discuss the problem involved in the foregoing case. Accepted contributions will be paid for.

Discussion

To Move or Not to Move

To move or not to move is a problem involving five main considerations, viz.:

(1) The good will or business-getting value of the present location. If it is central and there are competing shops nearby some trade will go there if they are accessible to trucks and automobiles. This involves today the question of parking space and traffic delays that exist now or will likely exist in the near future.

(2) The saving in rent as against the advantage of a new location not so centrally located. This question requires a rather nice exercise of judgment as to whether or not the rent saved will balance or exceed the business lost temporarily and permanently, plus the cost of making the move, or, at least, the interest on the cost of moving.

(3) The risk involved in moving accurate machinery. This risk is considerable, as the accuracy may be impaired. The time lost in moving must be counted against a move to a new location.

(4) The saving on the lower insurance rate outside of a congested area. This is a factor in favor of moving and involves only a few simple calculations to determine.

(5) The better light and ventilation obtainable in a less congested area. This helps to offset the objection mechanics may have to taking a longer time to go to and from a more centrally located shop. Loss from errors is less and the mechanics will unconsciously produce more and better work, or even if a slightly lower order of mechanics have to be used the improved light and air will enable them to produce, on the average, work of better men under worse conditions. There is also the saving due to the fact that it is not necessary to use as much artificial light. The question of proximity to a hardware store or supply house is settled before it is raised because the supplier of raw material and tools must make deliveries under present competitive conditions and do it promptly.

Location of a jobbing shop convenient to shipping facilities is secondary unless a large proportion of the work done is for out of town accounts and this is not usually the case. The local customer delivers and receives the work at the shop door on his own truck and out-of-town customers will not as a usual thing contest a hauling charge added to the shop time and material bill.

The shop owner, if he has his shop so located that he is not annoyed by a lot of petty jobs that might come to him in a central location, can devote more time to overseeing his men, studying faster methods and cultivating generally the trade that is more desirable.

Banking facilities sufficient for the small shop owner are always available in the form of small banks or branches of large ones. Uncle Sam has solved the mail and parcel post problem.

In these days of rapid transit and the almost universal use of automobiles unless the shop is moved to a very remote place the customer who has business at the shop does not have any difficulty getting there. —J. P. KEMP.

Allowances for Old Machines

I have been following with considerable interest Mr. Holland's weekly advice, and I sincerely believe that on the above topic has been his best to date. That the thing we buy in the final analysis is production, and not a machine, is a truth that can bear constant repetition. If Mr. Wilson were tempted to accept the Brown offer, he must bear in mind that the purchase of the machines may close the transaction as far as he is concerned, but that Brown still has his profit to make. So, if he subsequently decides on any special equipment for the machines, or is so unfortunate as to have a breakdown, Brown cannot help but feel that here is his opportunity to reap some of that postponed profit on the special or replacement parts and the service incidental thereto. In the case of the Stanley machines, however, since Stanley has made his profit at the proper time and place, namely, on the machines themselves, he will be inclined to let him have the additional parts or service at what is practically equivalent to cost.

In changing machines, there is an intangible but nevertheless existant loss to be faced in the attitude of the men. The Stanley machines have won their confidence—any changes are hailed as improvements and enthusiastically mastered. The Brown machines, even though they may be equally good, earn their resentment for every feature wherein they differ from the good old Stanleys. This mental attitude on the part of the men, hard though it is to measure, soon eats up the extra allowance on the old machines. —C. F. FUREY.

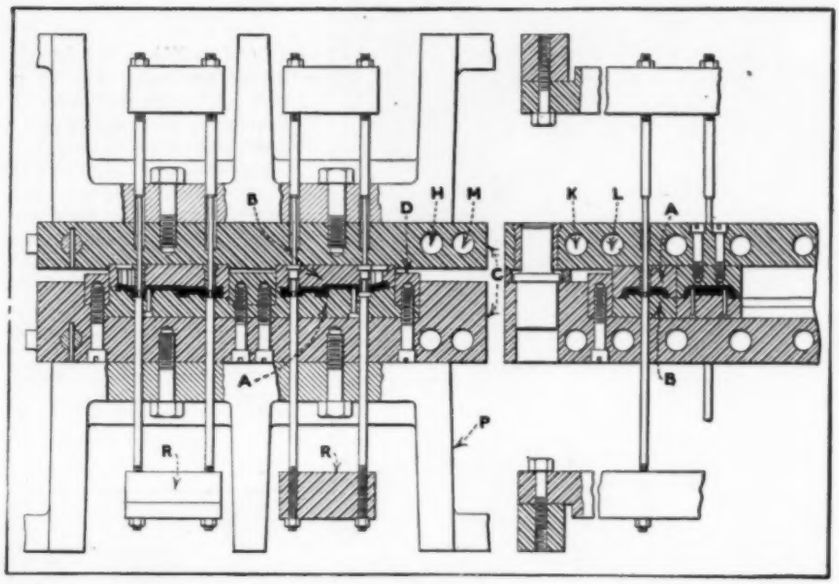


Fig. 1—Constructional details of a Bakelite molding die showing the steam plates

Bakelite Molding Methods

By FRANK W. CURTIS
Western Editor, American Machinist

BAKELITE is a synthetic product, created from formaldehyde and phenol, which form a resin-like material that hardens when subjected to heat. In brief, commercial Bakelite is molded by placing the mixed ingredients, which generally include wood flour or asbestos powder, used as a filler, in a steel mold, or die, and then squeezing them under pressure. Heat is applied to the mold, causing the mixture to solidify, commonly called curing, after which water is passed through the same openings in the mold for cooling purposes.

At the Bakelite division of the Reynolds Spring Company, Jackson, Mich., hydraulic presses are used for the making of molded parts, their capacities ranging from 20 to 125 tons, in accordance with the class of work being handled. A pressure of approximately 2,000 lb. per sq.in. is applied, as this force has been found to render a product that will not decompose. When quantity production is desired, presses of larger capacities are employed, utilizing multiple dies that mold several parts simultaneously, whereas the smaller presses are used for short run work or for parts of a special nature.

Molds for the average run of work consist of an upper and a lower die, so constructed that when the dies are closed there remains a cavity between them, corresponding to the outline of the part to be molded. The dies are attached to steam plates which are aligned by guide pins such as used in sub-press dies. A ten-unit mold assembly for making a section of an electrical cord connection is illustrated in Fig. 1, showing the upper and the lower dies at *A* and *B* respectively, and the steam plates at *C*. The side sectional view at the right shows only two of the five die sections, inasmuch as the remaining sections are a replica of that portion illustrated. Individual die blocks are used throughout so that if a single section is broken, or becomes worn beyond further use, it can be replaced without having to change the entire die set. Guide plates *D* are attached to the lower steam plate to support the dies *B*, as well as align the upper dies *A*, when the mold is in the closed position.

Steam holes are drilled longitudinally and traversely in the steam plates, after which the majority of them are provided with diverting plugs, so that the steam will follow the longest channels. In the case shown, for example, steam enters the hole *H* and then passes to the hole *K* where it is diverted to travel to the rear of the steam plate. Here the steam is diverted to the next cross hole *L*, where it again travels to the foreward part of the plate, and then, likewise, is diverted backward and forward until it is exhausted through the hole *M*. This arrangement permits a uniform heat to be applied throughout the entire die section. The curing temperature of the mold is approximately 360 deg. F., whereas the temperature to which it is lowered by water is about 100 deg. F. Since the upper section travels with the ram of the press, its steam connections are made with flexible metallic tubing to compensate for the vertical movement.

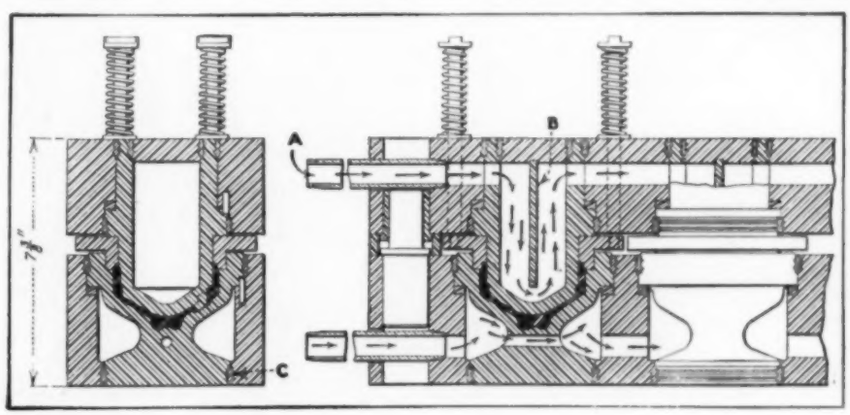


Fig. 2—Molds used in making products having a deep section are constructed so that the die sections form part of the steam plate. The steam is caused to travel in such a path that uniform heat is delivered throughout the die faces. Hammered leaded joints are provided between the contacting faces of the dies and the steam-plate body to insure steam-tight connections. The steam connections for the upper section are made by means of flexible piping

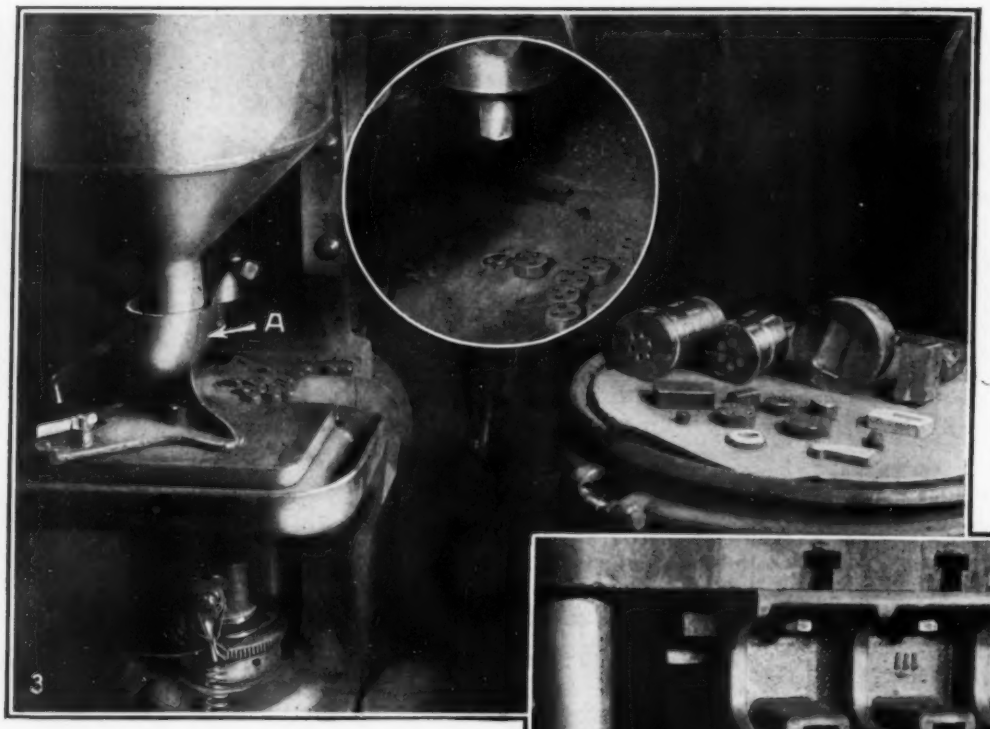


Fig. 3 — When the ingredients are measured by a cup, or by weight, there is likelihood of error in preparing the correct amount; therefore, in most cases, the raw material is compressed to tablet form in this machine. Dies and punches to suit the shape of the tablet are used. The insert shows a close-up view of a die and a punch in place, while at the right are shown several dies and tablets

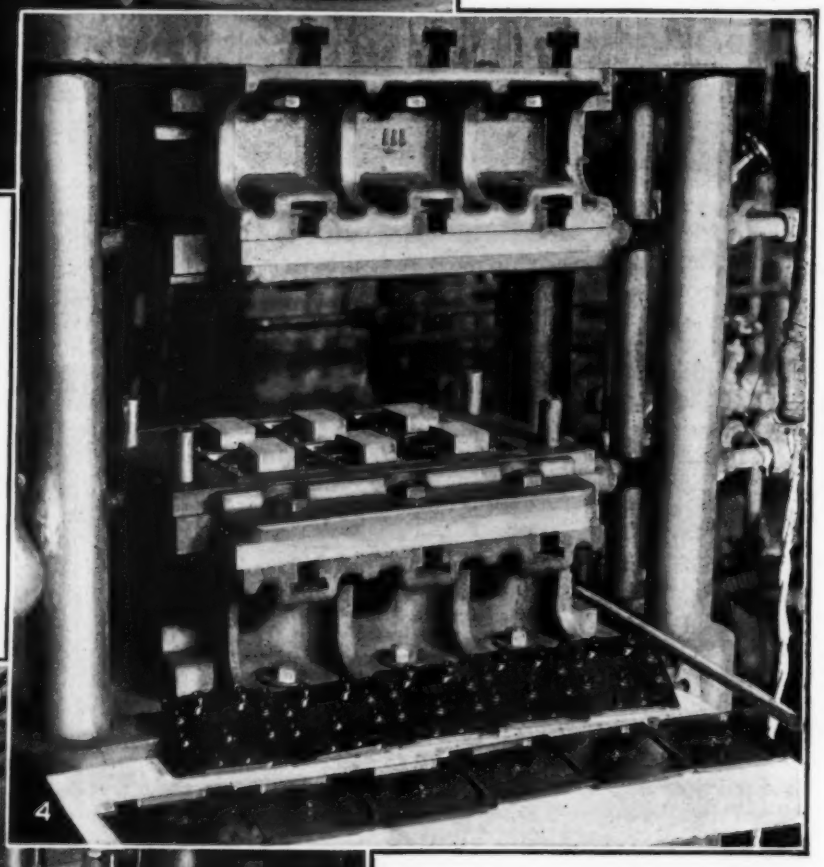


Fig. 4 — A six-unit mold set in a press, showing the tablets in place in the lower die section and a number of finished parts at the front of the machine. A pressure of approximately 2,000 lb. per sq.in. is used to spread the tablet over the die face, and to hold the dies in place while the mixture is being cured at 360 deg. F. Water at about 100 deg. is then used to cool the work

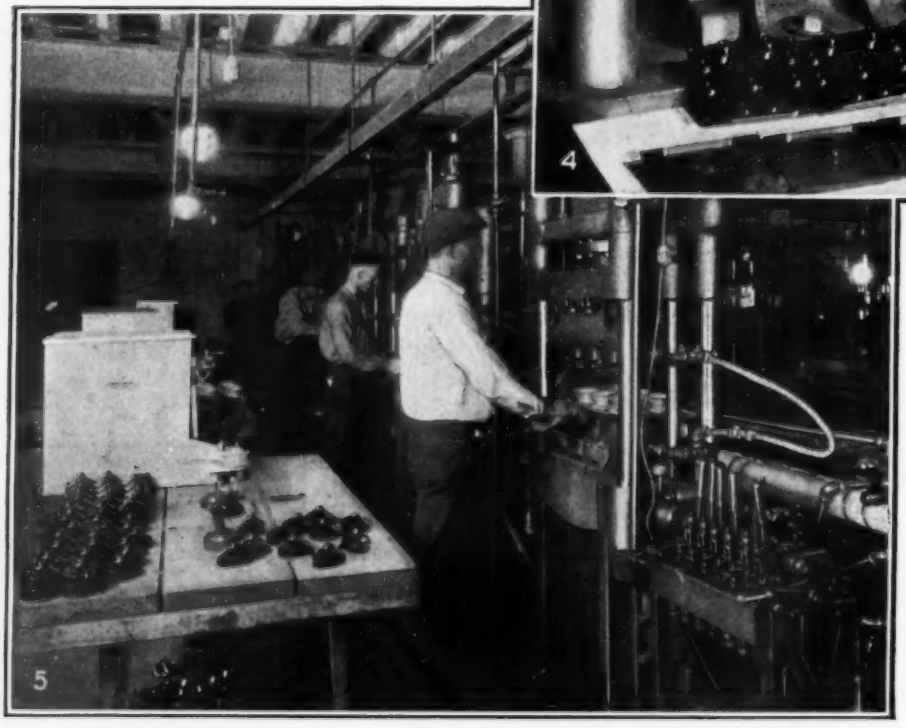


Fig. 5—A battery of molding presses in operation making a variety of parts. The first press has mounted in it the die shown in detail in Fig. 1, while on the table are shown some of the completed pieces. At the left is illustrated the electrically-operated device that automatically controls the cycle of the press. The only duties of the operator are to load the tablets and to unload the finished work

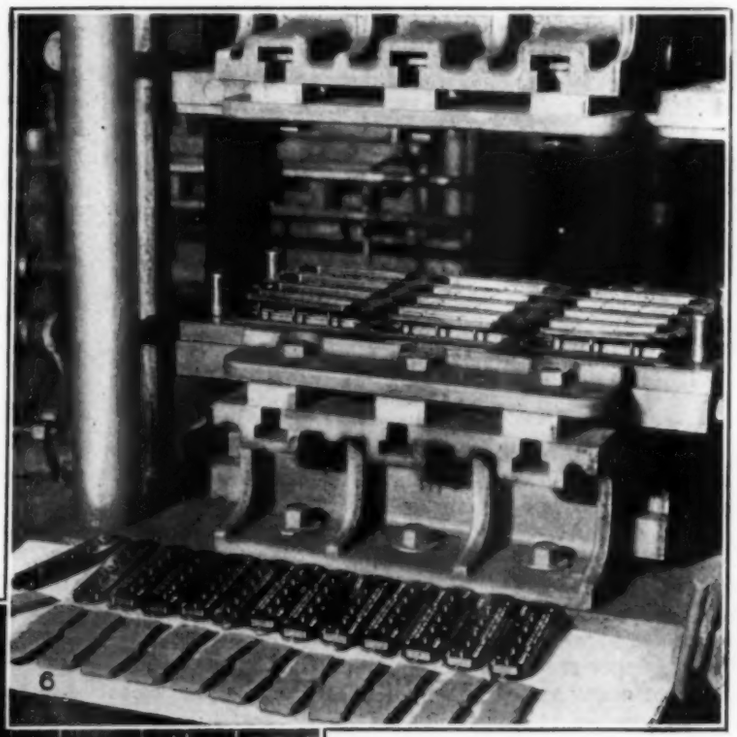


Fig. 6 — A twelve-unit mold shown as it appears after the ram has been raised, illustrating how the work is ejected from the lower die sections. Several finished pieces, together with the tablets from which they are made, are shown at the front of the mold. The use of tablets not only insures the application of the proper amount of Bakelite but also saves considerable time in loading a mold. Guide pins are applied to the mold to aid alignment of the upper and the lower sections when the machine is in the closed position

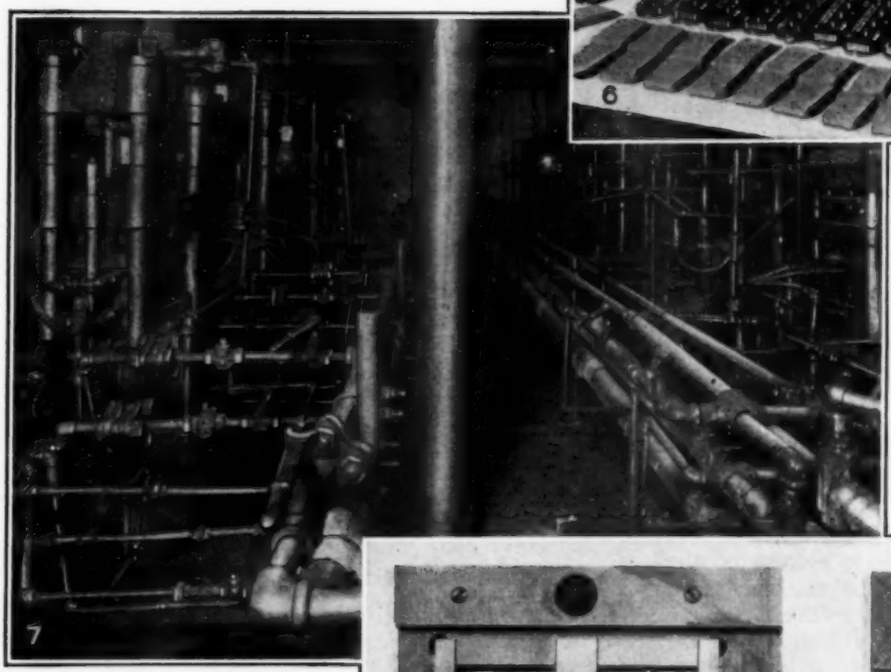


Fig. 7 — Piping for a battery of molding presses requires a quantity of connections. Each press is supplied with cut-off valves, so that any required number of machines may be placed in use. This view illustrates the rear sides of two rows of presses. An aisle of sufficient width is left in the central portion to permit adjustments and repairs. The piping is inspected daily

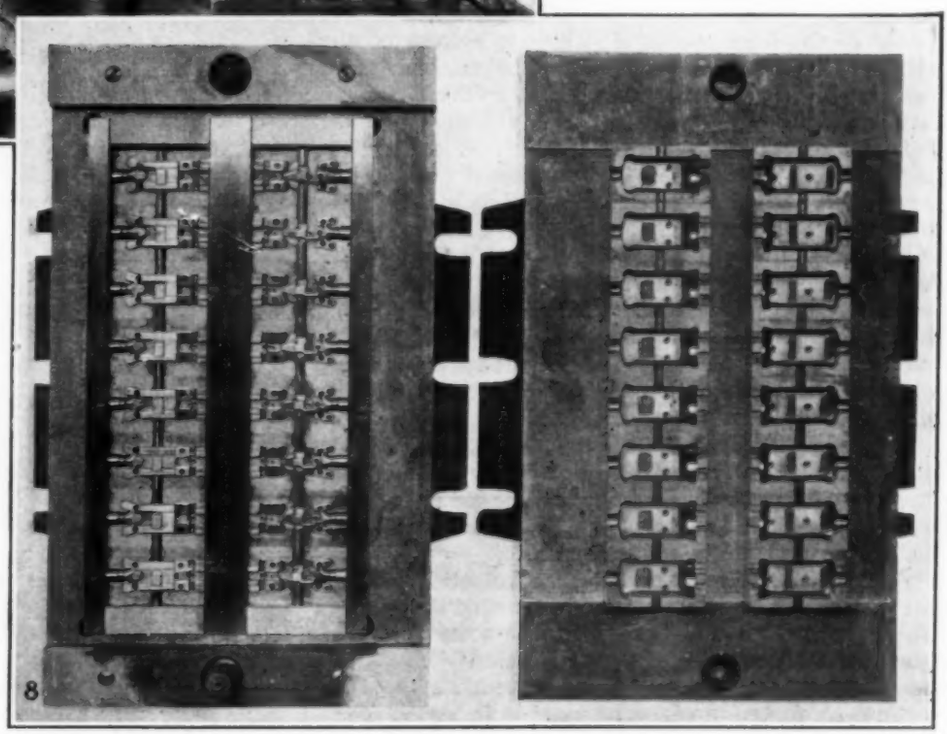


Fig. 8 — Upper and lower sections of a mold that makes sixteen electrical cord connections simultaneously. Each die section is made individually so that if necessary it can be replaced without having to change the entire die set. Dies are made by sinking a hob, by means of hydraulic pressure, into a soft steel block. The block is somewhat larger than required to guard against the possibility of having the edges cave in. The block is finally machined to size, hardened and polished

In connecting the molds to the press, grid plates such as shown at *P* are mounted between the steam plates and the machine to prohibit a free flow of heat from the molds. The grids are cored to permit air to circulate around their surfaces, as well as to provide a suitable space for the ejector bars *R*. These bars, operated in connection with the press ram, have ejecting pins attached to them, which strip the finished molded part from the dies when the press opens.

In making a set of dies having an irregularly-shaped depression, the practice is to sink a hardened hob, resembling the outline desired, into a soft steel block by means of hydraulic pressure, thus eliminating the cost of die sinking. The size of the block is generally much larger than the size of the die desired, so that the pressure exerted in hobbing will not fracture, or cave in, the edges of the impression. After an impression has been made the block is machined to size and then carburized, hardened and polished, making it ready for use.

For certain classes of work having a deep section dies and steam plates such as have been outlined cannot be used, in which case molds such as shown in Fig. 2 are constructed. This illustration shows a portion of a six-unit mold in which the dies form part of the steam plate. In the upper section steam enters at *A* and passes into the first plug chamber where it is diverted to pass close to the point of contact by means of the plate *B*. In the lower section the steam passes through a cavity that surrounds the die, and then passes through a hole into the next die units. Grooves are machined at the upper and the lower points of the dies, and the steam plate body, as shown at *C*, which are filled with lead and hammered at assembly, to form a steam-tight fit.

Bakelite in Tablet Form

To offset the possibility of measuring inaccurately a stipulated quantity of Bakelite, which is often handled by means of a measuring cup, or by weight, the mixed ingredients are compressed into tablet or pill form, corresponding in size to the shape of the part desired, in the machine illustrated in Fig. 3. The ingredients are placed in the hopper, shown at the upper left, and then passed to the feeding arm *A*, which is pivoted on the table, and made to oscillate when the machine is in motion. A die is inserted in the table, so that when the feed arm, carrying the mixture, passes the die, the mixed ingredients fall into the die, filling the opening. When the arm returns it levels the mixture flush with the die face, after which the punch descends, compressing the mixture into tablet form. An ejector, working in connection with the ram stroke, strips the finished tablet from the die, so that the arm pushes the finished tablet into the chute as it proceeds to the filling position. The machine is automatic in operation making 60 pills per min. At the right is shown a variety of tablets together with the dies used, while in the insert is shown a close-up view of a die and a punch mounted in the machine.

A complete six-unit mold for making radio recharger plates, set up in a press, is illustrated in Fig. 4. At the front of the mold are shown some of the completed parts while on the lower die section may be seen the rectangular tablets from which the plates are made.

A battery of molding machines is illustrated in Fig. 5, the first of which is equipped with the mold described in Fig. 2, while on the table may be seen some of the finished parts made in it. At the extreme right is shown the electrically-operated switch that controls the automatic cycle of the press. The cycle includes the lowering of the ram after the tablets have been loaded, the turning on of the steam for curing, the exhausting of the steam and the deliverance of the water for cooling, and the withdrawal of the ram combined with the ejecting of the work. Timing is arranged so that the operator has sufficient time to unload and load the mold before the ram again starts downward. Between 3 and 5 min. are required to complete a cycle, depending upon the nature of the work being molded. The control is automatic in order to eliminate the uncertainty of the human element.

A twelve-unit die is illustrated in Fig. 6, showing how the work is ejected from the lower die section prior to being removed. At the front of the mold are shown the finished parts and the tablets from which they are made. The mold, on account of its size, has four guide pins, although it is connected to the grids as previously described.

The piping required for two batteries of presses is illustrated in Fig. 7. The main steam- and water-feed lines, passing at the rear of the machines, have cut-off valves for each press, so that only those machines required for service need be hooked in. A sixteen-unit mold used for making electric cord connections is illustrated in Fig. 8 in the open position, showing the upper and the lower die sections.

Metal and wooden inserts can be incorporated into molded products by following the procedures outlined, with the exception that the inserts are placed in the die section prior to putting in the tablets. In some cases, especially where a considerable number of inserts are required, the time cycle is altered slightly to allow the operator sufficient time to complete loading the mold. The inserted portions of metal are made with grooves and knurled surfaces, so that they practically form an integral part of the product. In molding parts having a wooden insert, such as the ball handle of a transmission shift-lever, the insert is generally shaped so that it cannot become loosened, as well as being constructed to permit a means of locating so that the entire surface becomes covered.

Machinability of Metals

THE machinability of cast iron and other metals has long been a subject for discussion, in fact, ever since it was discovered that hardness and ease of cutting bore little direct relation to each other. Scleroscope, Brinell and Rockwell tests all show the hardness of metals in the usual accepted sense, but they give the machine man little clue as to how they will cut.

Some shops have adopted cutting tests, using standard cutting tools, and compare results with those obtained from a satisfactory metal. Both drills and shapers are used in such tests and have been found very much worth while. Using a twist drill of given diameter, ground to a standard cutting angle and freshly sharpened before each test, gives very uniform results. A standard speed and a weighted, or constant-pressure feed, shows the comparative "cutability" of the different metals.

Using this method, one large builder of machines has been able to so change his mixtures as to secure a closer-grained iron of higher tensile strength and get higher cutting speeds than before. By following the results secured in the cutting tests, machining time can often be materially lessened.

Tests of this kind need not however be confined to large shops, they will be found useful in many places.

Measurement of the Thickness of Involute Gear Teeth

By Allan H. Candee
Gleason Works, Rochester, N. Y.

Wherein the author amplifies and supplements a phase of the general subject of gearing covered by Earle Buckingham in these pages—Development of the formulas for pin measurement

MEASURING the distance across round pins or plugs placed between the teeth on opposite sides of a gear to determine the tooth thickness is an old practice. This method of measuring is illustrated in Fig. 1. It gives very accurate results and is especially valuable for holding gears to standard sizes, but up to the present time it appears to have been used only to a very limited extent. The reason for this has undoubtedly been that there was not a short and convenient way of determining the correct dimension across the pins. The present article includes tables from which the dimension across the pins for standard involute spur gears can be obtained very easily, and direct methods of calculation are given for special cases of spur gears and for helical gears. There are several reasons why the pin method of measuring gear tooth thickness is more accurate and sensitive than measurement by more usual means, such as the almost universally used gear tooth calipers.

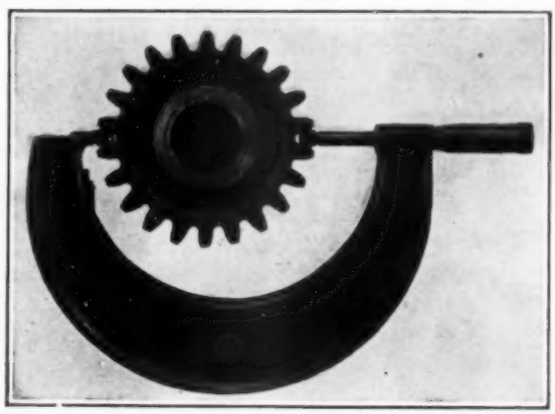


Fig. 1—Pin measurement of gear tooth thickness

1. The micrometer calipers used to obtain the dimension over or between pins can easily be read with an error not greater than 0.0002 in., whereas the limit of accuracy in reading a vernier scale is nearer 0.001 in.

2. The pin method is entirely independent of the outside diameter of the gear teeth

3. In using measuring instruments the workman generally has to obtain the correct setting by the sense of feeling. It is comparatively easy for anyone to feel the right micrometer setting over the pins

4. A slight error in setting or reading the micrometer means a considerably smaller error in tooth thickness. In fact, an error in dimension over the pins is multiplied by the tangent of the pressure angle in obtaining the corresponding error in tooth thickness which is therefore only one-fourth or one-third as great. With any direct-reading instrument, the whole amount of any error in setting or reading is transferred to the tooth thickness

5. Finally, with the pin measurement method, contact occurs only between tangent surfaces that are almost free from wear.

The pin method of measuring gear tooth thickness was adopted by the Gleason Works as standard practice for small spur gears early in 1927. It immediately proved to be of great practical value by reducing the probable error in tooth thickness measurements to less than one-tenth of that previously existing. If the same gear tooth is measured with the same tooth vernier calipers by a number of different workmen, their individual readings for tooth thickness will undoubtedly vary by more than plus and minus 0.001 in., which means a range in thickness of at least 0.002 in. With the pin method, however, the readings can easily be kept within a range of 0.0005 in., which means about 0.00015 in. on tooth thickness. In general the pin measurement method is most suitable for fairly small gears of diameters within the capacity of the usual shop set of micrometer calipers. It is with gears of this size, of course, that the increased accuracy obtainable is especially worth while. For instance, it is possible with the pin method of measurement to cut standard spur change gears in stock quantities for installation on fixed center distances with extremely small allowances for backlash, and be fully confident that they can be assembled satisfactorily. Previously, with the old method of thickness measurement, there was always danger that such gears would be either too tight or too loose.

In devising a system for measuring gear teeth by means of pins, it is at once obvious that a standard series of pin diameters is desirable. Some of the systems that have been proposed from time to time in the past have required a different pin diameter for each different number of teeth, and so were quite unsatisfactory for general use. In the system now to be described there is one standard pin diameter for each standard diametral pitch. The same size of pin is used for teeth of both 14½- and 20-deg. pressure angle. Also, the pin diameter adopted is large enough to cause the pin to project slightly beyond the tops of the teeth so that it is possible to measure even the smallest pitches with ordinary micrometers.

In explaining the way in which the dimension across the pins is calculated, it will first be necessary to give the

The first article of a series of three. The second will follow in an early issue.

derivation of certain simple fundamental properties of the involute curve. In Fig. 2 the involute curve illustrated has a base circle with center at O and radius b. Probably the most common way of describing the involute of a circle is to say that the curve is traced by the end of a taut string unwinding from the circumference of the circle. Thus, in the diagram the string PM when wrapped completely on to the circumference has its end P lying at point A, called the point of origin of the curve. Then as the string is unwound from the circumference of the circle its end traces the curve AP. Of course, any point in the string may be considered as tracing its corresponding involute.

At P the radius to the center is r; and a straight line through P and tangent to the base circle has a point of tangency at M. The pressure angle α at P is angle POM. In triangle POM

$$r = b \sec \alpha \qquad (1)$$

In all problems dealing with the thickness of involute gear teeth at different diameters or radii there is involved the value of the angle between the radius to a given point on the curve and the radius to the point of origin on the base circle. In Fig. 2 this is indicated as

$$\theta = \text{angle } POA$$

From the way in which the involute curve can be traced by a point in a string unwinding from the circumference of the base circle, it is evident in the diagram that

$$\text{arc } MA = MP$$
$$= OM \tan \alpha$$
$$= b \tan \alpha$$

Then letting β $= \text{angle } MOA$

and since in radian measure

$$\text{angle} = \text{arc}/\text{radius}$$
$$\text{angle } MOA = b \tan \alpha / b$$

or $$\beta = \tan \alpha$$

Finally, in the diagram

$$\text{angle } POA = \text{angle } MOA - \text{angle } MOP$$

or $$\theta = \tan \alpha - \alpha \qquad (2)$$

Also the length of arc from P to the radial line through A is of course

$$\text{arc } PP_1 = r\theta = r(\tan \alpha - \alpha)$$

Equation (2) gives the characteristic mathematical relation of angles for the involute curve. The two equations

$$r = b \sec \alpha \qquad (1)$$

and $$\theta = \tan \alpha - \alpha \qquad (2)$$

are the parametric polar equations for the involute of a circle, and are the basis of most calculations dealing with tooth thickness.

A good name for the angle POA in Fig. 2 is the "involute angle." The value $(\tan \alpha - \alpha)$ has been called the "involute function" of the pressure angle α and abbreviated "inv α" by Prof. Earle Buckingham in his article on "The Design of Gear Tooth Forms," on page 555, Vol. 64, of the *American Machinist*.

For greatest convenience in dealing with involute gear tooth problems a table of the values of the involute function of α is essential. The writer constructed such as table for his own

Table I—Values of the Involute Functions of α

Inv $\alpha = \tan \alpha - \alpha = \theta$

Sec α	Inv α	Diff.	Tan α	α	Sec α	Inv α	Diff.	Tan α	α
				Standard Angles					
1.033	0.00555		0.259	14° 30′	1.0642	0.01490		0.364	20° 0′
				Part 1					
1.001	0.00003	5	0.045	2° 34′	1.021	0.00284	21	0.206	11° 38′
1.002	0.00008	8	0.063	3° 37′	1.022	0.00305	21	0.211	11° 55′
1.003	0.00016	8	0.078	4° 26′	1.023	0.00326	21	0.216	12° 10′
1.004	0.00024	9	0.090	5° 7′	1.024	0.00347	21	0.220	12° 26′
1.005	0.00033	11	0.100	5° 43′	1.025	0.00368	22	0.225	12° 41′
1.006	0.00044	11	0.110	6° 16′	1.026	0.00390	22	0.230	12° 56′
1.007	0.00055	12	0.119	6° 46′	1.027	0.00412	23	0.234	13° 10′
1.008	0.00067	13	0.127	7° 13′	1.028	0.00435	24	0.238	13° 24′
1.009	0.00080	14	0.135	7° 40′	1.029	0.00459	24	0.243	13° 38′
1.010	0.00094	14	0.142	8° 4′	1.030	0.00483	24	0.247	13° 52′
1.011	0.00108	15	1.149	8° 28′	1.031	0.00507	25	0.251	14° 5′
1.012	0.00123	16	0.155	8° 50′	1.032	0.00532	25	0.255	14° 18′
1.013	0.00139	16	0.162	9° 11′	1.033	0.00557	25	0.259	14° 31′
1.014	0.00155	17	0.168	9° 32′	1.034	0.00582	26	0.263	14° 44′
1.015	0.00172	17	0.174	9° 52′	1.035	0.00608	26	0.267	14° 57′
1.016	0.00189	18	0.180	10° 11′	1.036	0.00634	26	0.271	15° 9′
1.017	0.00207	19	0.185	10° 29′	1.037	0.00660	27	0.275	15° 21′
1.018	0.00226	19	0.190	10° 47′	1.038	0.00687	27	0.278	15° 33′
1.019	0.00245	19	0.196	11° 5′	1.039	0.00714	27	0.282	15° 45′
1.020	0.00264	20	0.201	11° 22′	1.040	0.00741	28	0.286	15° 57′
				Part 2					
1.041	0.00769	28	0.289	16° 8′	1.061	0.01382	34	0.354	19° 31′
1.042	0.00797	28	0.293	16° 19′	1.062	0.01416	34	0.357	19° 40′
1.043	0.00825	28	0.297	16° 31′	1.063	0.01450	34	0.360	19° 49′
1.044	0.00853	29	0.300	16° 42′	1.064	0.01484	34	0.363	19° 58′
1.045	0.00882	29	0.304	16° 53′	1.065	0.01518	35	0.366	20° 7′
1.046	0.00911	29	0.307	17° 3′	1.066	0.01553	35	0.369	20° 16′
1.047	0.00940	30	0.310	17° 14′	1.067	0.01588	35	0.372	20° 25′
1.048	0.00970	30	0.313	17° 24′	1.068	0.01623	35	0.375	20° 33′
1.049	0.01000	31	0.317	17° 35′	1.069	0.01658	35	0.378	20° 42′
1.050	0.01031	31	0.320	17° 45′	1.070	0.01693	36	0.381	20° 50′
1.051	0.01062	31	0.323	17° 55′	1.071	0.01729	36	0.384	20° 59′
1.052	0.01093	31	0.327	18° 5′	1.072	0.01765	36	0.386	21° 7′
1.053	0.01124	31	0.330	18° 15′	1.073	0.01801	36	0.389	21° 15′
1.054	0.01155	32	0.333	18° 25′	1.074	0.01837	37	0.392	21° 24′
1.055	0.01187	32	0.336	18° 35′	1.075	0.01874	37	0.395	21° 32′
1.056	0.01219	32	0.339	18° 45′	1.076	0.01911	37	0.397	21° 40′
1.057	0.01251	32	0.342	18° 54′	1.077	0.01948	37	0.400	21° 48′
1.058	0.01283	33	0.346	19° 4′	1.078	0.01985	37	0.403	21° 56′
1.059	0.01316	33	0.349	19° 13′	1.079	0.02022	38	0.405	22° 4′
1.060	0.01349	33	0.352	19° 22′	1.080	0.02060	38	0.408	22° 11′
				Part 3					
1.081	0.02098	38	0.410	22° 19′	1.101	0.02898	42	0.461	24° 44′
1.082	0.02136	38	0.413	22° 27′	1.102	0.02940	42	0.463	24° 51′
1.083	0.02174	38	0.416	22° 35′	1.103	0.02982	42	0.465	24° 57′
1.084	0.02212	39	0.418	22° 42′	1.104	0.03024	43	0.468	25° 4′
1.085	0.02251	39	0.421	22° 50′	1.105	0.03067	43	0.470	25° 11′
1.086	0.02290	39	0.423	22° 57′	1.106	0.03110	43	0.472	25° 17′
1.087	0.02329	39	0.426	23° 5′	1.107	0.03153	43	0.475	25° 24′
1.088	0.02368	40	0.429	23° 12′	1.108	0.03196	43	0.477	25° 30′
1.089	0.02408	40	0.431	23° 20′	1.109	0.03239	43	0.479	25° 37′
1.090	0.02448	40	0.434	23° 27′	1.110	0.03282	43	0.482	25° 43′
1.091	0.02488	40	0.436	23° 34′	1.111	0.03325	43	0.484	25° 50′
1.092	0.02528	40	0.439	23° 41′	1.112	0.03368	44	0.486	25° 56′
1.093	0.02568	41	0.441	23° 48′	1.113	0.03412	44	0.489	26° 3′
1.094	0.02609	41	0.443	23° 55′	1.114	0.03456	44	0.491	26° 9′
1.095	0.02650	41	0.446	24° 3′	1.115	0.03500	44	0.493	26° 15′
1.096	0.02691	41	0.449	24° 10′	1.116	0.03544	45	0.495	26° 21′
1.097	0.02732	41	0.451	24° 17′	1.117	0.03589	45	0.498	26° 28′
1.098	0.02773	41	0.454	24° 24′	1.118	0.03634	45	0.500	26° 34′
1.099	0.02814	42	0.456	24° 30′	1.119	0.03679	45	0.502	26° 40′
1.100	0.02856	42	0.458	24° 37′	1.120	0.03724	45	0.504	26° 46′

Table I (Continued)—Values of the Involute Functions of α

Sec α	Inv α	Diff.	Tan α	α	Sec α	Inv α	Diff.	Tan α	α
				Part 4					
1.121	0.03769	45	0.507	26° 52′	1.141	0.04703	48	0.549	28° 47
1.122	0.03814	45	0.509	26° 58′	1.142	0.04751	48	0.552	28° 53′
1.123	0.03859	46	0.511	27° 4′	1.143	0.04799	49	0.554	28° 58′
1.124	0.03905	46	0.513	27° 10′	1.144	0.04848	49	0.556	29° 3′
1.125	0.03951	46	0.515	27° 16′	1.145	0.04897	49	0.558	29° 9′
1.126	0.03997	46	0.518	27° 22′	1.146	0.04946	49	0.560	29° 14′
1.127	0.04043	46	0.520	27° 28′	1.147	0.04995	49	0.562	29° 20′
1.128	0.04089	46	0.522	27° 34′	1.148	0.05044	49	0.564	29° 25′
1.129	0.04135	47	0.524	27° 39′	1.149	0.05093	49	0.566	29° 30′
1.130	0.04182	47	0.526	27° 45′	1.150	0.05142	49	0.568	29° 36′
1.131	0.04229	47	0.528	27° 51′	1.151	0.05191	49	0.570	29° 41′
1.132	0.04276	47	0.530	27° 57′	1.152	0.05240	50	0.572	29° 46′
1.133	0.04323	47	0.532	28° 2′	1.153	0.05290	50	0.574	29° 51′
1.134	0.04370	47	0.535	28° 8′	1.154	0.05340	50	0.576	29° 56′
1.135	0.04417	47	0.537	28° 14′	1.155	0.05390	50	0.578	30° 2′
1.136	0.04464	47	0.539	28° 19′	1.156	0.05440	50	0.580	30° 7′
1.137	0.04511	48	0.541	28° 25′	1.157	0.05490	50	0.582	30° 12′
1.138	0.04559	48	0.543	28° 31′	1.158	0.05540	51	0.584	30° 17′
1.139	0.04607	48	0.545	28° 36′	1.159	0.05591	51	0.586	30° 22′
1.140	0.04655	48	0.547	28° 42′	1.160	0.05642	51	0.588	30° 27′
				Part 5					
1.161	0.05693	51	0.590	30° 32′	1.181	0.06733	53	0.628	32° 8′
1.162	0.05744	51	0.592	30° 37′	1.182	0.06786	53	0.630	32° 13′
1.163	0.05795	51	0.594	30° 42′	1.183	0.06839	54	0.632	32° 18′
1.164	0.05846	51	0.596	30° 47′	1.184	0.06893	54	0.634	32° 22′
1.165	0.05897	51	0.598	30° 52′	1.185	0.06947	54	0.636	32° 27′
1.166	0.05948	51	0.600	30° 57′	1.186	0.07001	54	0.637	32° 31′
1.167	0.05999	52	0.602	31° 2′	1.187	0.07055	54	0.639	32° 36′
1.168	0.06051	52	0.604	31° 7′	1.188	0.07109	54	0.641	32° 40′
1.169	0.06103	52	0.606	31° 12′	1.189	0.07163	54	0.643	32° 45′
1.170	0.06155	52	0.607	31° 16′	1.190	0.07217	54	0.645	3 °49′
1.171	0.06207	52	0.609	31° 21′	1.191	0.07271	54	0.647	32° 54′
1.172	0.06259	52	0.611	31° 26′	1.192	0.07325	54	0.649	32° 58′
1.173	0.06311	52	0.613	31° 31′	1.193	0.07379	55	0.651	33° 3′
1.174	0.06363	52	0.615	31° 36′	1.194	0.07434	55	0.652	33° 7′
1.175	0.06415	53	0.617	31° 40′	1.195	0.07489	55	0.654	33° 12′
1.176	0.06468	53	0.619	31° 45′	1.196	0.07544	55	0.656	33° 16′
1.177	0.06521	53	0.621	31° 50′	1.197	0.07599	55	0.658	33° 20′
1.178	0.06574	53	0.622	31° 54′	1.198	0.07654	55	0.660	33° 25′
1.179	0.06627	53	0.624	31° 59′	1.199	0.07709	55	0.661	33° 29′
1.180	0.06680	53	0.626	32° 4′	1.200	0.07764	56	0.663	33° 33′

use in 1920. This table consisted of the first three columns printed in Table I of the present article and gave the values of sec α and inv α with differences for the latter. The two additional columns in the table as printed here, for tan α and α, have been included to make it unnecessary to refer to any other tables for the required trigonometric values. A very complete table of values of inv α for angles from 0° to 60° varying by intervals of 0°1′ was given by Professor Buckingham in the article to which reference was just made, and in his book.

Before proceeding to the calculations for pin measurements it will be worth while to see how the table of inv α is used in calculating the change in tooth thickness in going from one gear diameter to another. In Fig. 3, T_1 and T_2 are the arc thicknesses of an involute gear tooth on diameters D_1 and D_2 respectively, and the corresponding pressure angles, although not indicated on the diagram, are understood to be α_1 and α_2. It is apparent that if

$$\Delta \text{ inv } \alpha = \text{inv } \alpha_2 - \text{inv } \alpha_1$$

$$T_1 = \left(\frac{D_1}{D_2}\right) T_2 + D_1 \Delta \text{ inv } \alpha \quad (3a)$$

and

$$T_2 = \left(\frac{D_2}{D_1}\right) T_1 - D_2 \Delta \text{ inv } \alpha \quad (3b)$$

When a slide rule is to be used for the required calculations, very much greater accuracy results by transforming these equations so that only small differences are calculated in the various steps, instead of large whole values. Thus, by letting

$$\Delta D = D_2 - D_1$$

we can write equations (3a) and (3b) thus

$$T_1 = T_2 - \left(\frac{\Delta D}{D_2}\right) T_2 + D_1 \Delta \text{ inv } \alpha$$

and (3c)

$$T_2 = T_1 + \left(\frac{\Delta D}{D_1}\right) T_1 - D_2 \Delta \text{ inv } \alpha \quad (3d)$$

We will confine ourselves to the second of these new equations, which gives the tooth thickness at a new gear diameter larger than the first diameter. Let the total change in tooth thickness be

$$\Delta T = T_1 - T_2$$

also let the change in tooth thickness due directly to change in diameter be

$$\Delta_D T = \left(\frac{\Delta D}{D_1}\right) T_1$$

and let the change in thickness due to the involute profile be

$$\Delta_a T = D_2 \Delta \text{ inv } \alpha$$

Of course, finally

$$\Delta T = \Delta \ T - \Delta_D T$$

and

$$T_2 = T_1 - \Delta T$$

Next, since the base diameter

$$D_b = \frac{D_1}{\sec \alpha_1} = D_1 \cos \alpha_1$$

and also

$$D_b = \frac{D_2}{\sec \alpha_2} = D_2 \cos \alpha_2$$

therefore

$$\frac{D_2}{D_1} = \frac{\sec \alpha_2}{\sec \alpha_1} = \frac{\cos \alpha_1}{\cos \alpha_2}$$

Then, by the rules of proportion

$$\frac{D_2 - D_1}{D_1} = \frac{\sec \alpha_2 - \sec \alpha_1}{\sec \alpha_1}$$

and letting $\Delta \sec \alpha = \sec \alpha_2 - \sec \alpha_1$ we get

$$\Delta \sec \alpha = \frac{\Delta D}{D_1} \sec \alpha_1$$

To consider a numerical example, let us suppose that

$D_1 = 5.000$ in.

$\alpha_1 = 14\frac{1}{2}$ deg.

$T_1 = 0.390$ in.

and it is required to calculate the tooth thickness T_2 on a different diameter, $D_2 = 5.200$ in.

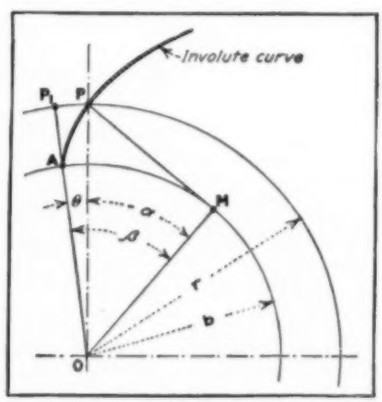


Fig. 2—Development of the involute curve

Carrying out the calculations in the manner indicated above we have:

$$\Delta D = 5.200 - 5.000 = 0.200 \text{ in.}$$

$$\sec \alpha_1 = \sec 14^\circ\ 30' = 1.0329$$

$$\Delta \sec \alpha = \left(\frac{\Delta D}{D_1}\right) \sec \alpha_1 = (0.2 \div 5.0)\ 1.0329$$

$$= 0.0413$$

$$\sec \alpha_2 = \sec \alpha_1 + \Delta \sec \alpha$$

$$= 1.0329 + 0.0413 = 1.0742$$

From Table I by interpolating for sec α_2 we obtain

$$\text{inv } \alpha_2 = 0.01844$$

$$\text{inv } \alpha_1 = 0.00554$$

$$\Delta \text{ inv } \alpha = 0.01290$$

$$\Delta_D T = \left(\frac{\Delta D}{D_1}\right) T_1$$

$$= (0.2 \div 5.0) \times 0.390 = 0.0156 \text{ in.}$$

$$\Delta_\alpha T = D_2\ \Delta \text{ inv } \alpha$$

$$= 5.200 \times 0.01290 = 0.0671 \text{ in.}$$

$$\Delta T = \Delta_\alpha T - \Delta_D T$$

$$= 0.0671 - 0.0156 = 0.0515 \text{ in.}$$

$$T_2 = T_1 - \Delta T$$

$$= 0.390 - 0.0515 = 0.3385 \text{ in.}$$

Of course, if the work is done on a calculating machine, it is shorter to use the direct equation

$$\sec \alpha_2 = \left(\frac{D_2}{D_1}\right) \sec \alpha_1$$

and also to calculate $\left(\frac{D_2}{D_1}\right) T_1$ as in equation 3*b* above.

Johnson Jolts Free Service

By John R. Godfrey

JOHNSON had been having a run-in with a fellow manufacturer about service for a milling machine that had decided to take a vacation after giving nearly a year of uninterrupted service. So the user had wired an S.O.S. to the maker who sent a service man over three hundred miles to see what the trouble was.

Adjustment was a simple matter—a pin had worked out of a driving clutch and the service man had the machine running in less than two hours after he started to work. Then, strange to say, the maker had braced up his backbone to the point of sending a bill for repairs, time, railroad fares and expenses, and old man Johnson happened in when Jones had just seen the bill.

"Outrageous impudence, Mr. Johnson. The idea of sending me a bill for making his old milling machine run. Never ought to have gone out of commission. Poor designing or poor workmanship, or something. I won't pay it."

Johnson is a pretty fair-minded chap anyhow, and then, too, he rather enjoys being on the other side of an argument, so he sailed in:

"Jones," said he, "you haven't got a leg to stand on. Of course you'll pay that bill—and you ought not to kick a minute."

"And why not?"

"Now see here. I remember when you got that machine in the shop. It's almost a year ago—and you sure bragged about it a lot. Told me it was making a great saving and would pay for itself in a year. Why should the builder of that machine keep it in repair? That's your job. It's your machine—not his."

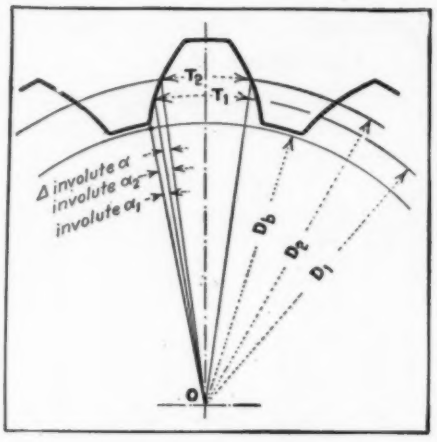


Fig. 3—Calculation of tooth thickness at various diameters, general base

"But no machine builders ever sent me a bill like that before. They've been glad to send men to keep our machines running, and never charged us a cent." "They may have sent men to you," said Johnson, "but I don't believe they were overjoyed at the prospect — not unless they enjoy spending money better than most of us. And why should they? Do you send out men to keep your old sausage machines in order? Do I send out a man when some user can't start his motor because a pin has dropped out of a gear? You bet we don't. We expect the men who own machines either to have gumption enough to find the trouble and fix it or hire someone else to do it for them."

"But they have always done it, Johnson."

"I know it, and I'm glad to see they're getting a little horse sense about it."

"Why glad? They'll be sending you a bill next."

"I'll tell you why I'm glad. When they spend money coddling customers, it means they put it in the price of their machines or go broke. If it's in the price of the machine, I pay for having service men come to *your* plant when your own men haven't gumption enough to find the trouble themselves. If my men ever get to the point where they send for a man to stick a pin back into a clutch, I deserve to be stung good and proper.

"After a man has earned darn near a hundred per cent on his investment for a milling machine, he's got an awful gall to expect the maker to repair it free."

"But the pin shouldn't have come out."

"Granted, Jones. Neither should anything ever go wrong with your sausage stuffer or my motors. But it does. We don't even guarantee sound material after ninety days. And then we expect the machine builder to play wet nurse to his machine as long as it stays on the job.

"When my own men can't find what's wrong and fix it—it's up to me to pay someone who can. Just remember that we need the machine builder just as badly as he needs us. We'd be in a nice mess if he quit on us—and I'm mighty glad that one of them has screwed his courage up to the point of demanding pay for service when his machine needs attention, after it has demonstrated its ability to do all he claimed for it."

Johnson isn't the only one who feels that way, either!

Aluminum alloy pistons seem to have overcome the objections and prejudices of opponents. It is stated that 32 car and engine builders are now using this type of piston and that, of these, 14 are also using a similar metal in the connecting rods. The reduction of weight in reciprocating parts has been found highly desirable as engine speeds have increased and smoother operation has been demanded by engineers and users.

· THE · FOREMAN'S · ROUND · TABLE ·

The following narrative is a "case" presentation of the topic. It has been written to involve some of the questions that arise in the average shop. For guidance in preparing discussion the questions at the foot of the page have been prepared

Too Many Safety Signs

"SAY, Al, did you hear about Williams refusing to let the insurance agent put up a lot of 'Safety' signs in the shop?"

"Yes, I did, Ed. Seemed a bit funny to me, so I asked him how he figured it out."

"Seems darn funny to me, too, Al. And the super preaching safety to us in season and out. How come, Al?"

"Now, don't go jumping at conclusions, Ed. Williams isn't any less keen on safety than he has been. But he has a new slant on how to get it."

"It's still Greek to me, Al. Spill it."

"Well, Williams has a friend who also runs a shop—and one where they've had mighty few accidents. They had a safety campaign in his town and the insurance company offered a medal to the shop with the best showing for a three-month period.

"Williams' friend refused to let them put up any signs in his shop—or to tell his men anything about the contest or the award. He figured that his men were pretty careful, anyhow, and that if he plastered 'safety first' signs all over the place, it might get them to giving it so much thought that they'd get nervous and spill the beans."

"Well, how did that theory work out? Seem to me it's a good thing to keep the safety idea pretty prominent in any shop."

"So it does to me, Ed. But the answer is that the super's friend's shop won the medal hands down, without the men knowing they were supposed to be extra careful. And now he's got a nice, fancy medal that he doesn't know what to do with. So you see why Williams thought he'd try the same plan."

"Well, it doesn't sound like good dope to me, Al. It may have worked out in one place, but you can't make me believe you can't tell men when you want them to be careful."

"It seems to be a question of individual temperament or nerves, I should say, Ed. You know how fidgety some men get if you watch them! And how much more apt they are to make a mistake! Others don't mind at all, and speed up under it. Depends on the men, I guess."

"Looks like Williams ought to take down all the safety signs then, Al, to be consistent."

"No, Ed. I don't think so. That would be worse than putting up new ones, for it would seem to say that we were no longer interested in safety. And you know that isn't the case."

"Then what's the objection to sticking up some new signs to remind the men of it in a new way, Al?"

"Personally, Ed, I can't see that it would do any harm—and it might do some good. But I can see the super's point of view, also. Whenever I see a shop plastered over with safety signs till you can't see anything else—it sort of gets me provoked. Seems to be overdoing a good thing. I suspect that was Williams' idea. Anyhow, we haven't had an increase in accidents since he refused to put up the new signs."

Was Williams wise in refusing to put up the new signs? Or was Ed right in feeling that a change of signs might be a good thing? Did Al state the case correctly?

All foremen are urged to discuss these questions vital to their work; of course the

discussion is not limited to foremen. Letters accepted and published will be paid for.

Discussion of Earlier Topics

Making Time Studies

AL IS certainly right about not taking time studies under cover. If such a condition exists, it is because the management and the men who are applying time study do not understand the subject. Many companies that apply secret methods in taking time studies are heading for labor troubles, and the men operating under such conditions are certainly more than justified in "laying down" when they are being time studied. Standards set under such conditions are not time-study standards but are spy-study standards, and the term time study should never be applied to standards that are established under cover.

In order to take a real time study it is necessary for the time-study observer to be as close as possible to the operator, and the machine, and in order to get a correct study the operator and the time-study observer must co-operate to the fullest extent. I have yet to find a man who will not give an honest demonstration for an honest time study. You will, of course, run across men who are slow, but these men are not laying down—they are following their natural movements. Time studies should not be established from studies of men who are slow, but on an average fast operator.

The foreman should certainly keep in close touch with the time-study observer while a study is being taken. In addition, the foreman should build up the job to be studied before requesting the services of the time-study observer. Any change that the observer wishes to put into effect should in all cases be done through the foreman.

—W. H. TABOR.

Side-Tracking an Old Customer

THE practice of side-tracking an old customer with the idea of gaining favor with a new one is seldom justified. Williams' zeal for new business does not warrant the sacrifice of the company's goodwill, and his decision in this case is wholly wrong. Every good account on the books is worth money, and can be made to produce more business by being loyal to those who have been loyal to you. And it is just as well not to forget that it costs something to get these good accounts in the first place.

While there may be a few shop managers who have no scruples in regard to the methods they use to get new business, I do not believe that the attitude held by Williams is by any means general. In fact, I think that such practice is frowned upon by most well conducted shops. It is well to remember, also, that an old customer who has been with you for years and pays his bills regularly is generally worth two or three new ones. And the loss of one or two old accounts is often a signal of disaster that may end in the wreck of the firm.

—H. L. WHEELER.

BY BEING desirous of taking everything that comes along we sometimes make promises that are most difficult to carry out. To take advantage of the old customer is wrong. There is no reason why any good customer should be penalized for being good. Ed is right to a certain extent when he says that it is generally practiced, but those who do this will lose unless they receive permission to take a little more time to complete the job. It is coming more and more to the point of honest dealing in order to be successful. Many of us are fed up on false promises. To favor the old customer and to satisfy the new at any cost is good advertising for the shop.

—C. H. SUNDBY.

They Set Their Own Rates

PERMITTING the men to set their own rates might make things easier for the foreman by silencing complaints about piece rates, but such a system is not fair to all workers. The honest, conscientious workman would be at a big disadvantage compared to the faker who knows how to make his job look difficult. A piece rate is essentially a contract between the firm and the man, and should be arrived at openly, and be fair to both parties.

—CHARLES S. HAZARD.

HAVING the men set their own rates is certainly an interesting experimental development in co-operative manufacture. I believe that it has possibilities in small towns with few manufacturing industries, where employment is a sort of "big family" proposition. Under such conditions in a long established industry, where successive generations are engaged in the shop, the interests of the employees are closely linked with those of the employers.

THE·NEXT·TOPIC

Extra Pay for Extra Effort

ADVANCE QUESTIONS

When a straight piece work system is in use should the rate be maintained if the operator discovers a short cut? Should a bonus be given in addition?

Such, however, is not the condition in the average shop located in large cities where the complexities of modern life make it "every man for himself."

—HARVEY S. HIRSCHMAN.

Paternalism or Privacy?

THERE is nothing that tends to rile the men more than the company prying into their private and personal affairs. If they are getting a square deal as far as the money question is concerned, allowing them to have a decent livelihood, there is no reason why strings are attached that bind them in any way to do what they are forced to against their will. But there are exceptions to all rules, and illness or adversity brings something different into play. Then, it is perfectly correct for their superiors to try to assist in whatever capacity possible. As far as concerns showers, lockers, clean floors and the like, these should not be considered as adjuncts of paternalism, but as useful facilities to every truly up-to-date plant. The majority of workers today do not want to be obligated, or to have any percentage saved out of their envelope for a rainy day. —L. JACKSON.

EMPLOYERS know that workmen coming from well regulated homes, where well prepared foods are served, make the best workmen. With the mind free from financial worries or petty quarrels, the attention is concentrated on the work at hand. The welfare department may see clearly how conditions could be improved upon, but the homes needing helpful suggestions are the ones most likely to resent assistance, and to consider it in the light of interference. The average man resents paternalism, and if administered it has to be well disguised, like a small boy's dose of medicine. Otherwise, he will be inclined to consider it as charity.

—A. TOMLINSON.

THERE is a common impression that shower baths, cafeterias, baseball teams and other adjuncts of modern plants are supported with money taken from wages. An examination of wage scales, however, shows that quite the opposite is true. The reason is apparent. All these things, if wisely installed and directed, are aids to production. Clean, healthy, self-respecting workmen, with a friendly attitude toward their employer, turn out more and better production per man, which is the only sound basis for more wages per man.

"Put it in the pay envelope" is a fallacy we frequently hear, and the real facts in the case are that money wisely invested in man-building is returned many times over in the pay envelope and the dividend check.

—G. F. GRIFFIN.

Is the Kicker Always a Nuisance?

THE shop where the chronic kicker does not abide is a rare place indeed. It must be situated on some peaceful island where the sun always shines. Why, Ed himself is a kicker, almost every week in the *American Machinist* he is putting up a kick about something. How do you get that way, Ed? Just now you are kicking because there are too many kickers.

Bill Jones kicks about the cut in his rate fixed by the time-study man. Johnson kicks because his tool box is broken open by someone on the night gang, and asks the company to make good. Wilson missed a good overcoat out of the washroom, and said the company ought to provide lockers. Jim Ferguson kicks because the wash water has been cold all winter, and wonders if the engineer is trying to save coal. Yes, Ed, I know these fellows as well as you, but don't lose heart. You know, Ed, how a big wind storm blows over, and the sun comes out and warms things up. Just listen to Al once in awhile. —H. L. WHEELER.

IT IS a fact that the foreman who listens to the reasonable complaints, the ideas, and the suggestions made by his men is making use of valuable tools in bringing about a higher efficiency in his department. A great number of important cost reductions have resulted through the adoption of ideas and suggestions made by interested and thinking workmen. A foreman who does not recognize the fact that his men have the ability to think, to make suggestions, and to register constructive criticisms is the one who would classify this interest on the part of his men as kicks. Such a foreman will not have the full co-operation of his men, nor is he the type of foreman that industry needs today.

Of course, the destructive kicker, the whiner and fault finder is soon detected, and for the best interest of all concerned a workman with that nature should not be tolerated, if he can not be steered into the policy of making only constructive complaints.

—W. C. KOEHLER.

IF ONE of my men called my attention to a hole in the floor I would not think he was a nuisance. I could easily visualize a trucker with a load of castings, who might accidentally run his truck into it. If conditions were just right, some castings might roll on the operator's foot, or perhaps the machine might be damaged. In any case, the time required to pick up the castings might be sufficient to repair the floor. Is it not quite probable also that the superintendent and manager will think more of a foreman who keeps his department in order? Evidently Ed is not broad enough to see the possibilities, but at least he shows himself to be a good sport by admitting that Al may be right. —A. MATHIEU.

The Hidden Costs of Accidents

AN ADDITIONAL cause of accident expense is the damage done to the machine, even it is successfully repaired after the accident. Some part or parts of the machine may be weakened, thus causing breakdowns at some future date. An accident strains the machine in all parts, with the result that it cannot turn out its maximum output at the maximum speed with the same accuracy as before.

The upset to production, moreover, is not only due to the direct results of the accident, but also to the moral effect on the shop force. Men begin to lose confidence in themselves and in their machines, and careful men waste time taking precautions against imaginary dangers. Other men waste time in explaining to their fellow workmen how they would prevent accidents if they were

the boss. When a new hand starts in the shop he will be told about the accidents that happened, with more or less exaggeration, with the result that he thinks the shop is a dangerous one to work in.

W. E. WARNER, *England.*

Calling Down the Old Man's Relatives

IN DEFENDING the watchman, Al was supporting law and order. He was arguing for the conscientious performance of duty and for universal good. The watchman could not possibly have overlooked the offense. Had he done so, he would probably have been reported himself. Someone, whom he had previously had occasion to warn, perhaps, would have seen to it that the old man got to know. Moreover, in this case a third party was concerned; that is, the insurance company.

—F. C. EDWARDS, *England.*

WHILE serving as assistant employment manager sometime ago I was approached by the superintendent of the main plant relative to placing his nephew in the shop. He insisted that the boy be started at the bottom and that he must learn from actual experience or be deprived of promotion. He stated that he would not back him up as much as he would a stranger.

I was instructed to request a report from the timekeeper which would be unbiased and strictly confidential as to the boy's progress, punctuality and obedience. I was told that the boy's fitting for a desirable employee would rest with the employment department and the foreman and not once did the uncle want to be called in to advise. His uncle's advice was "Give him every promotion that he earns, but be ready to convince me that he has earned it honestly." The boy became assistant foreman in his department, and devoted time evenings to study of his work from books and from a correspondence course, but he never succeeded in gaining any favors as a relative.

—RUSSELL J. WALDO.

Co-operating on Theory and Practice

RESEARCH, while it is looked upon with scorn by the uninformed, is one of the vital factors in competitive progress, and must be a proven asset when consideration is taken of the large sums expended on it by industrial leaders in all lines. While there does not appear to be any common meeting ground in the shop for the theoretical engineer and the practical man, any problem that brings them together should be the real common meeting place. Aside from this, there should also be some effort made for them to get together at specified times for an exchange of views relative to their work.

—WALTER W. YAEGER.

THE amount of research work in a given industry is a fairly good index of the state of that industry. If it is meager and haphazard, it is more than likely that the industry will find itself frozen out from its old established markets. The largest organizations do considerable research work in technical laboratories of their own, but the results of their research become their own property and do not necessarily aid the whole industry. For the many thousands of separate organizations, the college acts as the research agent for the benefit of all who will take enough interest to formulate and apply their conclusions. The meeting ground for the theoretical engineer and the practical man in the plant is a function of their mental attitude toward each other, and the college production conference is a mighty good place and time to start this off right.

—W. F. MICHAEL.

Should the Super Talk to the Men?

IN MY judgment, Ed is absolutely wrong in thinking that all contact should be through him. Ed is in charge of a department to see that work is turned out properly and to maintain morale. The super is responsible for all departments, and as long as the super does not give men orders over Ed's head, he is right in talking to them. I believe that the super should visit various departments at certain periods, depending on the size of the factory. A super's personal contact with the individual worker is a good idea, and it is too bad that it is not practiced more than it is.

—PAUL LINDNER.

Foremen as Inspectors

IN A shop where general job work is done, large pieces machined and no two jobs alike, it is certainly necessary to have the foremen check the workmen closely. And on some difficult operation where long set-up time is involved, the foreman should check before tearing down the job. On the other hand, in such a shop as a large screw machine department, the foreman has enough on his mind to keep the wheels running without bothering with actual inspection. There should be an inspector in that department constantly checking the work. It is, of course, unnecessary to say that all good foremen constantly guard against defective material, not by inspecting the work but by seeing that the machines are in good shape, and by keeping in touch with the men on their work. Training new and old men, shifting them to the job they are best fitted for, getting as high-grade men as possible and keeping them satisfied, and taking care of sanitary conditions, all go together for good work. And these constitute the job of the foreman.

—A. C. NOLKE, *Superintendent of Planning.*

Shall It Be Layoffs or Short Time?

IT IS too much like asking the men to run the shop to put the question up to them as to whether they are to work short time or be laid off. Moreover, if changed circumstances should affect that decision so that the management would want to reverse it, it would find itself in the unfortunate position of having to explain itself to the men. Such decisions had best rest with the management.

In general, although it may not be such a humane decision, I would favor the layoff. This would reward the best workers for their past efforts by being retained, and weed out some of the inevitable "on the line" personnel. In addition, a shop working part time is never efficient, as the men have the conditions forcibly brought to their attention each day, and they tend to stretch the work as much as possible. A layoff has the opposite effect; it puts those retained up on their toes.

—NELSON A. BAIRD.

A Modern Boiler Shop for Railroad Repairs

Layout of the boiler shop—Machines for hot and cold flanging—Radial drill mounted on rails—Automatic machine for drilling staybolts—Machine for grinding superheater joints

BOILER work at the Paducah, Ky., shops of the Illinois Central System is handled in a separate building, lying parallel to the locomotive shop. It measures 624 ft. in length and 165 ft. in width. One section of the shop houses the machinery and the other the erection tracks, of which there are 25 arranged transversely. A layout of the shop is illustrated in Fig. 1, showing the general arrangement of the machinery. A portion of the southeast corner of the shop is shown in Fig. 2. The machine at the left is a 2,100-ton Southwark flanging press, while that at the right is a 66-in., 100-ton Chambersburg sectional flanging press. Both machines are hydraulically operated and have individual heating furnaces placed at convenient positions, so that plates can be transferred to the presses with a minimum amount of heat loss. One of the 15-ton cranes, serving the bay, is shown in part.

Flue sheets are flanged cold in the McCabe flanging machine illustrated in Fig. 3. It has a hand-operated jib crane located conveniently to it for the lifting of sheets to and from the machine table. When a sheet is being worked, the projecting end is supported by the portable stands shown at the right. The heads and bases are cast iron and are connected by upright members made of piping. Roller-bearing casters are mounted in the heads, enabling a sheet to be shifted easily. Similar stands of various heights are used throughout the boiler stop in connection with other machine work, such as punching and drilling, where much shifting is necessary.

An unusual radial-drill installation, shown in Fig. 4, is arranged for drilling, counterboring and trepanning miscellaneous boiler and flue sheets. The machine is a 7 ft. American radial, mounted on a track so that it can be shifted a distance of approximately 24 ft., thus enabling the drilling of large sheets without having to shift the work. Another advantage is that on smaller work, one side can be used for drilling while another job is being set up on one of the other sides. The foundation, made of cement and measuring approximately 18x31 ft., is somewhat lower than the floor level, so that it forms a drain for the cutting lubricant. The lubricant passes into a sump where it is first strained and then returned to a reservoir for reuse. Two clamps, one on each side of the base, lock the machine in the desired position.

The staybolt department, located at the east end of the shop, is illustrated in Fig. 5. The equipment includes a 6-spindle staybolt machine, power saws, a 12-spindle staybolt drill and a threading machine. Stock racks are provided for storage of bars and semi-finished material, and roller stock-supports, such as shown at the right, are available for use in connection with the cutting off of bar stock. A close-up view of the Richmond 12-spindle staybolt drill is illustrated in Fig. 6. The work is placed in the drum at the left, being automatically clamped as the drum revolves. The drill head likewise revolves and is arranged so that the drills are relieved three times during one revolution of the drum. Holes $\frac{7}{32}$ in. in diameter and $1\frac{1}{2}$ in. deep are drilled at the rate

The third article of seven. The fourth will appear in an early issue.

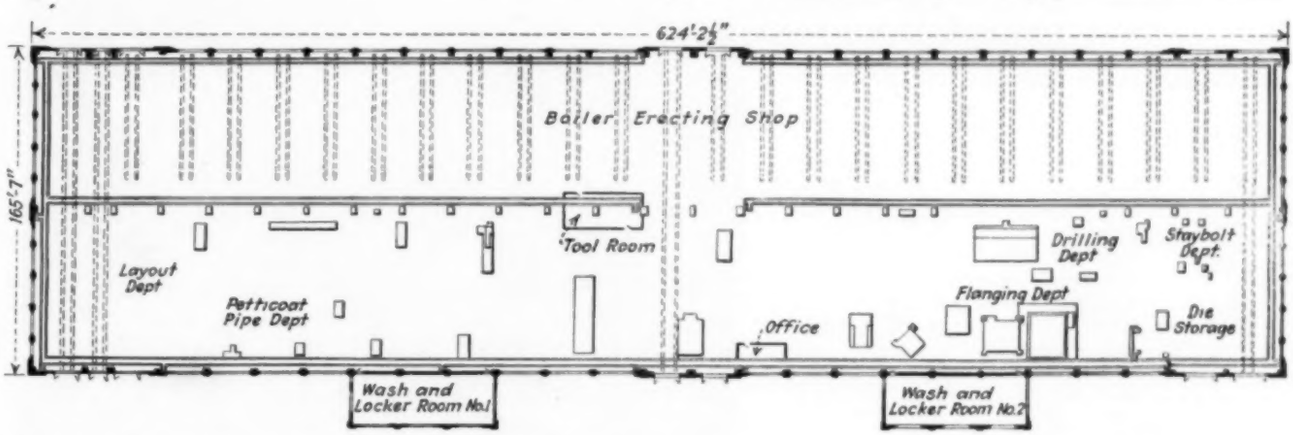


Fig. 1—Layout of the boiler shop, showing the arrangement of the machine department and the erecting bay. The shop is 624x165 ft. and has 25 working tracks in the erection bay. Two 15-ton cranes are provided in the machine department, while the erecting shop is served by a 75-ton gap crane so as to get the maximum lift

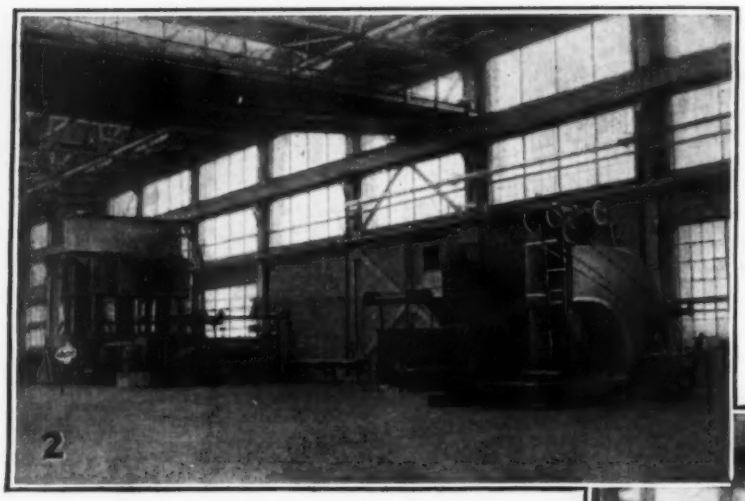


Fig. 2 — The shop is equipped with machines large enough to flange the largest boiler plates. Two of the hydraulic-type flanging presses are shown, the one at the left having a capacity of 2,100 tons, while that at the right, used for sectional flanging, is 100 tons. Individual furnaces are provided for each press to facilitate production. Overhead may be seen one of the cranes that serve the machine department

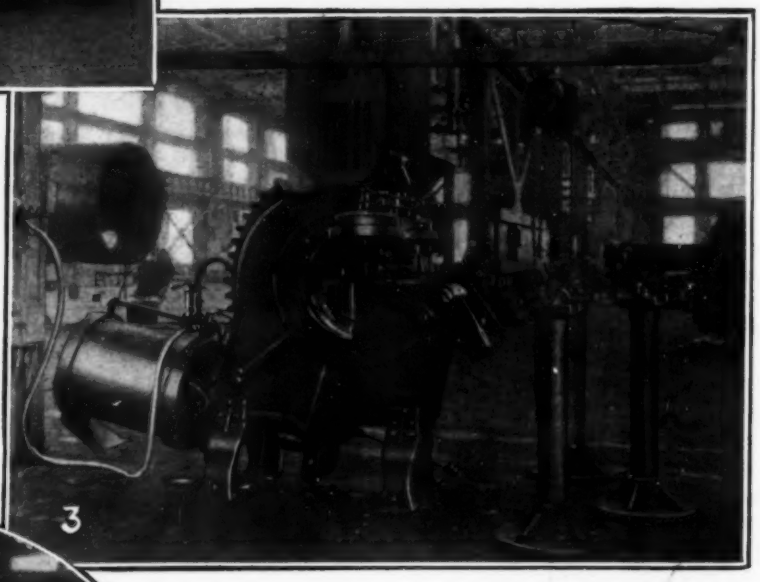


Fig. 3 — Sheets are flanged cold in this machine. It is portable so that it can be taken to any location in the shop, although the majority of work is formed at the location shown, where a jib crane is available to assist handling. Projecting sections of flue sheets are supported by portable stands equipped with ball-bearing casters for ease in shifting the work

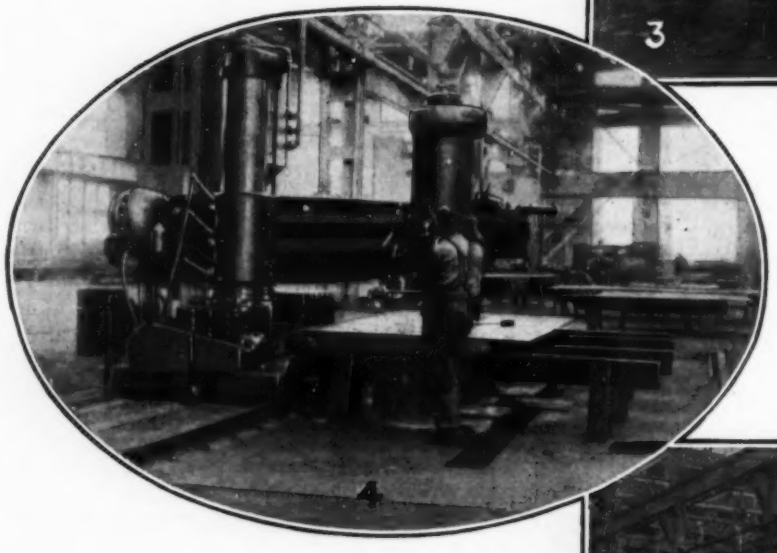
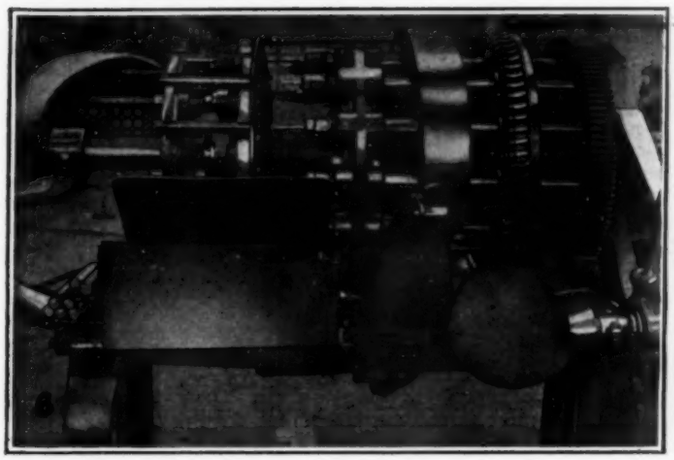


Fig. 4—This radial drill, mounted on tracks and having a travel of approximately 24 ft., is used for drilling and trepanning flue sheets. Large sheets can be handled at one setting. On smaller work it is possible to set up a job on one side while the job on the other side is being completed. Lubricant is drained through a floor outlet, and is returned to the machine

Fig. 5—Staybolts are made in a separate section of the shop, equipped with cutting-off, turning, threading and drilling machinery. Ample racks are provided for storage of bar stock and finished work. To aid in cutting off long bars, racks are used to support the projecting ends, as shown at the right



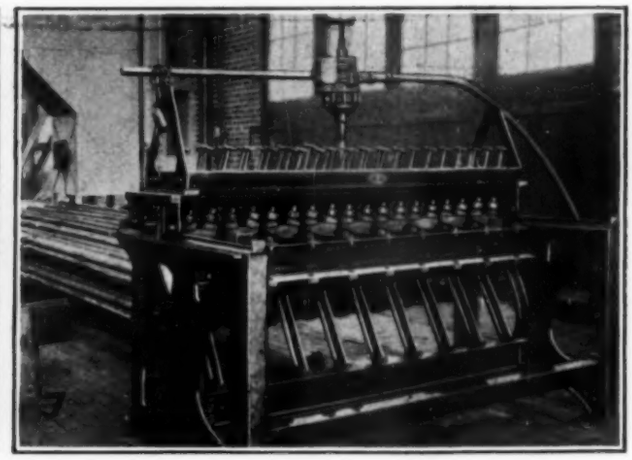


Fig. 6 — Staybolts are drilled in this machine, which is semi-automatic. The work is clamped by cam-operated fingers. The holes drilled are ⅞ in. in diameter and 1½ in. deep. Twelve pieces are accommodated. The drills are relieved three times during the drilling of a hole. Fig. 7—Seats of superheater joints are ground in this machine. The work is clamped close to the joint ends, while the projecting ends are supported on an adjustable rack. Approximately 1½ hr. is required to grind a set of joints so that they will be steam tight

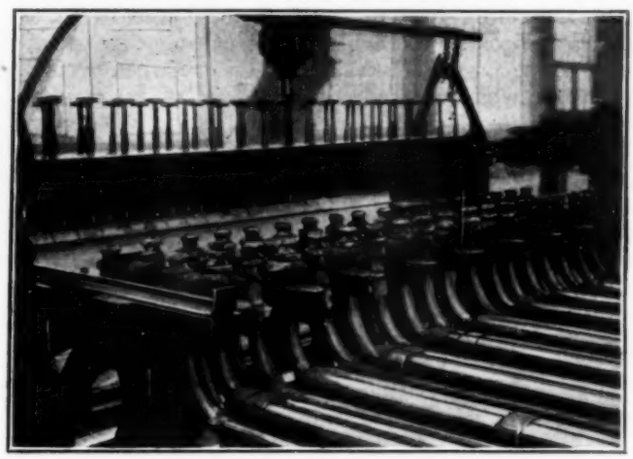


Fig. 8 — Rear view of the superheater-joint grinding machine, showing the method of loading the work. The spindles, driven through gearing by an air-operated motor, are mounted in a carrier head that revolves slowly

of twelve per minute, or in one revolution of the drum and spindle head.

Another single-purpose machine that is a considerable labor saver is a superheater-joint grinding machine, made by the Transportation Device Corporation, and illustrated in Fig. 7. The superheaters of which eighteen sets are accommodated, are held in place by clamps so that they lie in the proper position in relation to the grinding spindles. The spindles, driven through gearing by an air motor, are mounted in a carrier plate that has a slow rotary motion when in operation. The spindle heads likewise pass around the superheater joints, thus producing uniform seats. Abrasive dust mixed with grease is used as a grinding medium. Each spindle head is spring seated against the joint it is to grind, so that a uniform pressure is maintained. Approximately 1½ hr. is required to complete the grinding of a set of joints. The opposite side of the machine is shown in Fig. 8, illustrating how the work is clamped. When loading, the entire carrier head is shifted out of the way allowing ample room for placing and removing the work. The spindle heads in this view are shown withdrawn from their grinding positions, so that they clear the work.

When the spindles are in the position shown in this illustration there is ample room to remove the superheaters that have just been ground and to replace them with others without interference in any way.

Grinding Form Tools for Hobs and Taps

By H. Q. Munn
Walkerville, Ontario

TO GRIND form tools of even the simplest kind is a fairly delicate process, but in making tools for forming hobs such as are used for cutting gears or splines, even greater accuracy is required. Errors in the form or angles on the face of the tool must be held within 0.0002 in. The angles in particular require special attention, since, owing to the presence of the helix angle and in conjunction with the clearance angles, the symmetry of the tool is lost.

The best method of grinding these tools is necessarily the one that saves the most time and trouble by eliminating as far as possible the "cut and try" method. The method adopted in most shops is as follows: The tool is clamped in a compound angle fixture such as the one indicated in Fig. 1. The lower swivel is set to an angle

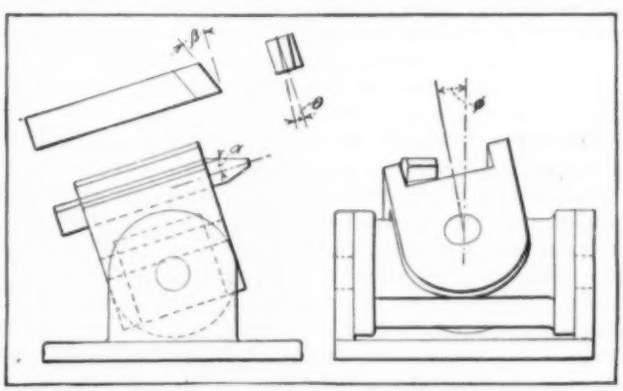
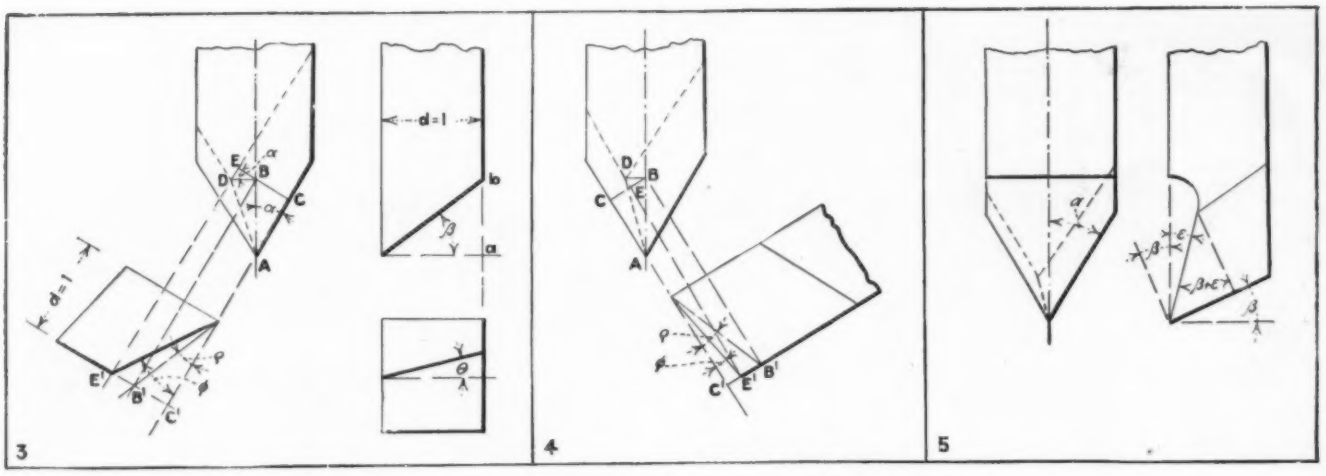


Fig. 1—Conventional compound-angle fixture for grinding form tools



Figs. 3, 4 and 5—Development of typical form-tool angles

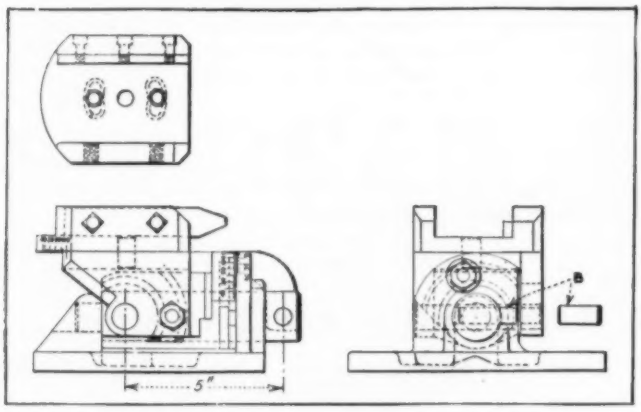


Fig. 2—Compound-angle fixture in which the tool is held with its axis in the same plane as that of the lower swivel. The angle to which the lower swivel is set is the side clearance angle measured normally

equal to α (the angle on the *face* of tool) and the upper swivel is set to an angle ϕ, equal to the angle through which tool is turned on its axis to give the necessary side clearance. Angle ϕ is found from formula:

$$\tan \phi = \tan \beta \tan \alpha \pm \tan \theta$$

These angles are set carefully to scales graduated in degrees. A cut is then taken, the tool removed and the angle checked with a sine bar and precision indicator. The tool is then put back in the fixture and any error noted is corrected by resetting the lower swivel, measuring the amount of correction by an indicator clamped on the wheel and resting against the face already found.

Even if we could set the lower swivel exactly to the angle α, we should not get a correct result because α is measured on the *face* of the tool, whereas we are actually turning the tool in a plane slightly inclined to the face of the tool.

We could calculate the correct angle corersponding to α, but even then any error in the setting of the other swivel would affect the accuracy of this angle when ground. Below is described a method by which the angle α can be ground correctly the first time, and the side clearance angles ground to close limits.

For this purpose a fixture as shown in Fig. 2 is advisable, or the standard type of fixture shown in Fig. 1 might be used, if, by means of some attachment, the tool can be held at a right angle to the existing jaws, and if we can set the upper swivel exactly to the angle α with axis of lower swivel. It will be noted in Fig. 2 that the axis of the tool is in same plane as axis of lower swivel, instead of being at a right angle as in Fig. 1. Since we are using the upper swivel for setting angle α, we are measuring this angle on the face of the tool.

Furthermore, since the axis of the lower swivel is always horizontal, the angle of the cutting edge, measured on the face, will always be the same when ground, no matter what the angle of the lower swivel may be. The angle to which the lower swivel is set is obviously the side clearance angle ϕ measured normally, and is different for each side of the tool.

The formula for this angle ϕ is derived as follows:

Let α = angle of cutting edge measured from center line

β = end clearance angle

θ = thread angle

Also let ρ = side angle on a section normal to cutting edge, if there were no thread angle.

Then ϕ = required side angle, measured normal to cutting edge.

CASE I—One side of tool:

Let d = unity, in Fig. 3, then $AB = \tan \beta$

$BC = AB \sin \alpha = \tan \beta \sin \alpha = \tan \rho$

Again $DB = \tan \theta$

$EB = DB \cos \alpha = \tan \theta \cos \alpha$

$EC = BC + EB = \tan \phi$

$\text{Tan } \phi = \tan \beta \sin \alpha + \tan \theta \cos \alpha$

CASE II—Other side of tool:

In Fig. 4, $BC = \tan \beta \sin \alpha$

$DB = \tan \theta$

$EB = DB \cos \alpha = \tan \theta \cos \alpha$

$EC = BC - EB = \tan \phi$

$\text{Tan } \phi = \tan \beta \sin \alpha - \tan \theta \cos \alpha$

Or, for both sides:

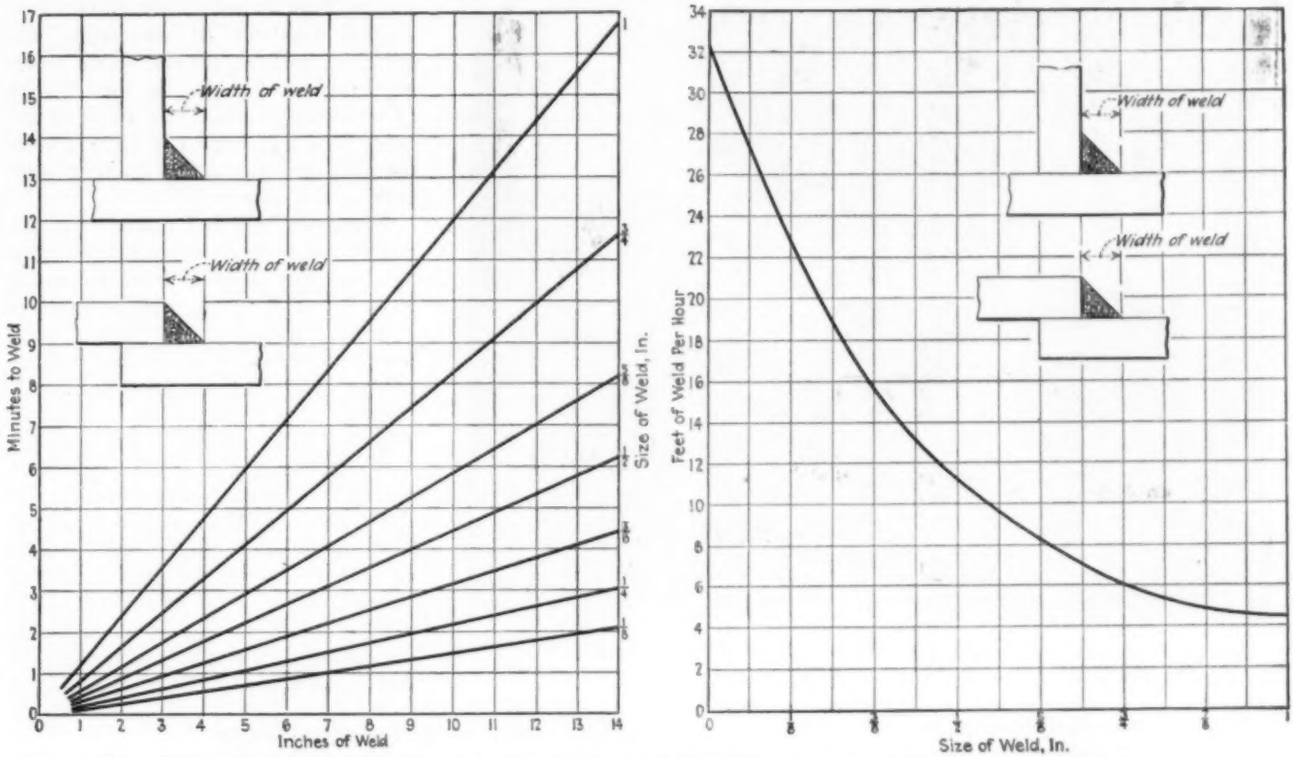
$$\text{Tan } \phi = \tan \beta \sin \alpha \pm \tan \theta \cos \alpha$$

If the tool has a hook, as in Fig. 5, we substitute $\beta + \varepsilon$ for β in the last formula, thus:

$$\text{Tan } \phi = \tan (\beta + \varepsilon) \sin a \pm \tan \theta \cos a$$

This expression is not theoretically exact because we are assuming θ is measured in a plane normal to face of tool instead of normal to the axis, but the error is negligible and in any case does not affect angle α. The jaws are then set to angle ε, and the face of tool is brought parallel with lower axis.

The fixture is designed especially low for use on a magnetic chuck. The angle of the upper swivel is set accurately by means of buttons, shown at *B*, Fig. 2, while lower swivel can be set by means of a vernier scale.



Figs. 1-2—Charts for estimating the piece-work speed of welding horizontal fillets with the metallic arc No allowance for set-up or fatigue is included

Time Study in Arc Welding

By C. J. Bowers and Forest Kessler

Chief of Time Study and Chief Welding Demonstrator
The Lincoln Electric Company

THE electric arc welder has passed the experimental and developmental stages of its growth and taken a foremost place in the ranks of production tools. This is true where its possibilities have been studied. But in many plants where investigation has been made of the cost of other types of work, welding is still often done on an hour-work basis, or without adequate time-study supervision. Welding is as susceptible of standardization as any machine operation. In fact it is more susceptible, for in welding there is a minimum of variable quantities to be considered in the work.

In reducing production welding to standardized operations, time studies and job instruction sheets are necessary. These sheets enable us to determine an equitable piece-work rate. That is their primary object, but there are others of almost equal importance. From the mass of accurate data we have compiled by means of them, we are able to make preliminary estimates that are remarkably close to actual cost, and to compute the probable saving that will be realized by substituting a welded assembly for a casting or a riveted job. All of this has proved to be an aid of appreciable importance to the designer.

One of the important factors to be considered is the proper placing of the welding operation in the production line. It is our custom to place welding in its natural production sequence wherever possible, with the obvious view of reducing handling to a minimum. To do this it is merely necessary to have a curtain erected at the desired point to protect the eyes of nearby workmen from the welding rays. Certain types of welding operations cannot be placed in line, and should be segregated in a department of their own, and generally supervised by a weld-

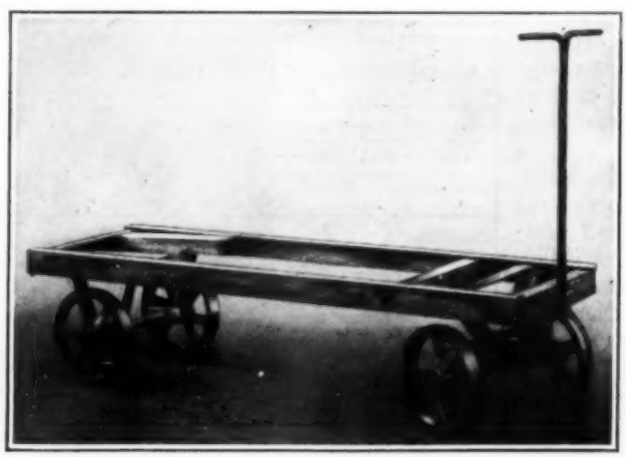


Fig. 3—An all-welded truck

Fig. 4—A set-up for production arc welding. The welding fixture for the truck platform shown in Fig. 3 is on the bench

and in Figs. 1 and 2 are shown two graphic methods of estimating the speed of welding fillets. The welding time depends on the total length of weld and on the size of bead required. In general the largest wire that will produce a satisfactory weld is the one to use.

For describing our method of procedure, we have chosen a fairly simple product, our welded truck shown in Fig. 3. The truck was reduced to several assemblies, and prints were sent to the toolroom for the making of the jigs. One of these fixtures is shown on the bench in the illustration, Fig. 4. This fixture is for the platform of the truck. The rear axle assembly is shown on the floor.

When the jigs were completed our welding demonstrator went to work on them. After he had produced several parts on a jig, it was carefully studied to see if it could be improved, or if the movements he had been making could be reduced.

Correct Current and Wire Sizes for Given Thickness of Plate

Thickness of Plate, In.	Size of Wire, In.	Amperes
1/16	3/32	80–125
	1/8	125–160
1/8	1/8	125–160
	5/32	160–180
3/16	3/16	180–200
1/4	3/16	200–225
3/8	3/16	180–225
	1/4	200–260
1/2	3/16	180–225
	1/4	200–260
5/8	3/16	180–225
	1/4	200–260
3/4	3/16	180–225
	1/4	200–260
	5/16	250–300
1	3/16	180–225
	1/4	200–260
	5/16	250–300

ing foreman. We use such a department for pieces that are either largely or wholly welded assemblies, or for parts that can be made in quantity, and kept in stock.

It is the duty of the time-study man to determine from experiment and analysis the exact amount and kind of welding that is necessary for any particular joint; to guard against over-welding and under-welding; to determine and set the correct welding heat (by amperage) and to select the right size and kind of wire. In the accompanying table is given the wire sizes and electric current that we use for any given thickness of plate,

STANDARD JOB INSTRUCTION SHEET

SKETCH

Article Truck
Operation Assemble & weld
Date 9-3-27 Type Welder Part No. L 507
Sta. No. 850 Observer CJB Part. No.
Base Rate $.70 Demonstrator Kessler Dwg. No.
Material Size
Lubricant
Machine
Jigs and Tools Used Jig D 6681
Remarks

Item	OPERATIONS IN DETAIL	R.P.M.	Feed	Depth Cut	Min. Sel. Time
A	Clamp top angles and cross pieces in jig. Use 4C clamps				3.85
B	Weld top on inside & weld 4 corners on outside				11.55
D	Place 5th wheel support & clamp				1.68
E	Weld " " " .				7.47
F	Remove C clamps				.25
G	Place rear wheel assembly				1.30
H	Weld " " " to top				2.50
I	Take assembly out of jig & lay on floor				1.55
	At this time complete those welds which can be made easier than above. Total times given above				
J	Place front wheel assemble, drive & spread 5th wheel cotter pin & grease 5th wheel				2.20
K	Pull truck into aisle				.45
	Total Min. Sel. Time				32.80

Study No. 350 A — Foreman O. K. — Supt. O. K. — TS. O. K.

ALLOWANCES:

Preparation Time		% of	Min.	
Handling "	10	% of	32.80	" 3.28
Machine " Hand Feed		% of		"
Machine " Power Feed		% of		"
		% of		"
Total Cycle Time with Working Allowances				36.08
Personal Allowance	2½	% of	36.08	Min. .90
Total Time Per Truck			Which Work Should Take	36.98
Rate Paid " " "				$.43

Form TS 604 IM-5-29-167757

Fig. 5—Typical job instruction sheet based on time study

For all time studies we use a demonstrator and an observer. In many shops it is customary for one of the regular welders to serve in the time studies, but we do not consider this to be the best practice. The demonstrator must not only be thoroughly competent as a practical welder, but he must also know heats and wires. In addition, he should be of an analytical turn of mind.

The study of the platform jig showed us the necessity of strengthening the fixture, and the advisability of simplifying its clamps. When this was done the demonstrator again worked on platform production to familiarize himself with all the operations. At the end of this educational period the observer joined him, and several platforms were made on which the time of every operation was carefully taken. The average of those times was placed on the job instruction sheet, Fig. 5, and the assembly given a standard piece-work rate. The sheet shown is typical of the job instruction sheets for any job of this kind. Where it is advisable, however, a sketch of the part being welded is given in the space in the upper left-hand corner of the sheet.

The sheets serve other purposes than the mere fixing of the piece-work price. They are blue-printed and given to the regular operators as detailed instructions. They show the men how to carry through a job with the least possible lost motion, and tell them exactly the time that any one operation should take. There is also another point in subdividing the operations. It may be found possible to eliminate a piece or pieces from an assembly as time and experience prove them unnecessary. With the sheets at our disposal on which the operations are subdivided, it is only necessary to take the time eliminated by the dropping of the piece and subtract it from the total to obtain the corrected time.

The schedules established by our time-study sheets are not hard for the average operator to meet. We habitually allow 10 per cent of the demonstrator's actual working time for incidental work, and 2½ per cent as a personal allowance. In making a time study the demonstrator does not attempt to work at the highest possible speed, but strikes a pace that his experience tells him is normal. For this reason, our operators are able to make ten or more per cent in excess of their hour-work basis.

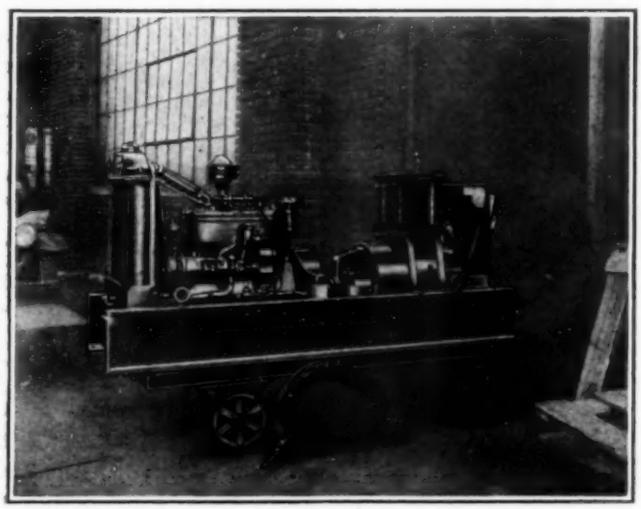


Fig. 7—All-welded steel base for an engine-driven welder

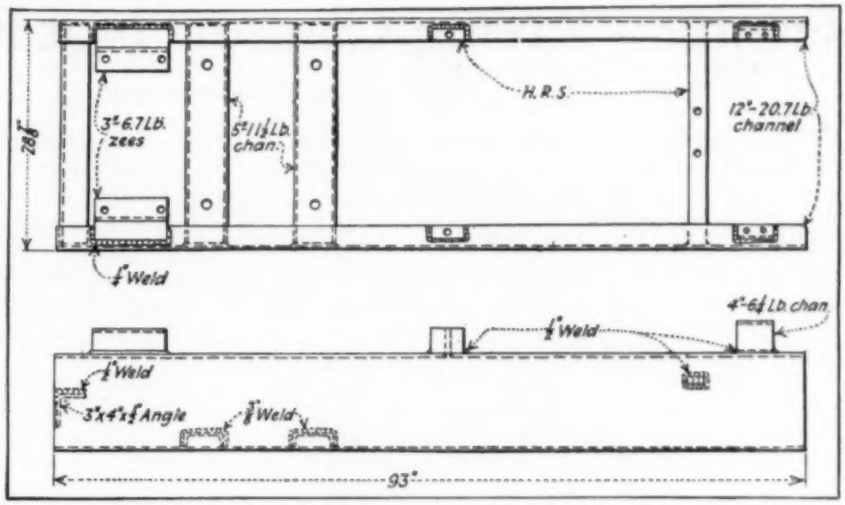


Fig. 6—Typical detail drawing for welders

It is often a good plan to break up a job into two operations, tack welding and finish welding. This is a good plan to follow where there are several welders, especially when the jigging time is a small percentage of the total time. In this way a beginner, at a lower rate of pay, can do the jigging and tack welding. This method eliminates the necessity of having more than one jig, and also enables one tacker to keep several welders busy.

In taking the detailed data, it is a good plan to keep the handling times separated from the welding times. The observer can then study each handling element separately to find which one can be improved, such as speeding up the jigging time by using quick operating cams instead of clamp screws.

In Fig. 6 is shown a detailed drawing of the base of the engine driven welder illustrated in Fig. 7. This is typical of many machine bases where welded steel replaces castings, and shows the method used by our engineering department to designate the location of welds and the size of weld required. While it would seem that more weld is called for than is actually required for strength, we have found it advisable on jobs of this kind to make exposed weld continuous for appearance. It will be noted that there is 2 ft. of ¼-in. bead, 2.2 ft. of ⅜-in. bead, and 9.2 ft. of ½-in. bead, or a total of 13.4 linear feet of welding. The total time for actual welding as determined by time study and given on the instruction sheet furnished with the job, is 64.32 min., giving a rate of 12.5 ft. per hour. Referring to Fig. 1 and 2, it is seen that the rate on ½-in. bead is 11.3 ft. per hour. As the majority of welding is ½-in. bead, the actual welding time checks very closely with the curves given.

Erratum

In the Reference Book Sheet, page 231, Vol. 68, of the *American Machinist*, it was stated that the Rockwell "B" readings were taken with a $\frac{1}{16}$-in. steel ball and 500-kg. major load. This should have been given as a 100-kg. major load.

Printed "Saving Clauses" Not Part of Contracts

By Leslie Childs

THE custom of printing saving clauses on order blanks and other stationery upon which contracts are written, is widely followed by machine shops and other manufacturing concerns. These clauses usually provide that all contracts are made subject to strikes, accidents and occurrences beyond the shop's control, and are used with the view of protecting the latter from liability for delay in making delivery for these causes.

Provisions of this kind are valid and binding if agreed to by the parties to the contract. But, where a provision of this character is merely printed upon a firm's stationery, used in the writing of contracts, and is not especially agreed to, it may not be considered a part of the contract.

It follows, that a machine shop executive, charged with the making of production contracts, may be treading on dangerous ground if he relies upon printed clauses to save his firm from liability for delays in deliveries, or for the completion of work as required by a given contract. The possible danger to a selling or manufacturing establishment in situations of this kind, is illustrated in a striking manner in the following Rhode Island case.

The Contract Terms

In this case a boiler works entered into a written contract to supply one Lewis with twelve extractors for the sum of $3,150.00. By the terms of the contract, the boiler works agreed to make delivery within a certain date and that it should forfeit a certain sum per day for each day of delay beyond the time named. Lewis on his part agreed to pay a bonus if delivery was made before the time stipulated in the contract.

The terms of the contract were written upon a letter head which carried a printed saving clause at its bottom as follows: "Prices subject to change without notice, and all agreements are contingent upon strikes, accidents and occurrences beyond our control."

When the terms of the contract were being arranged no mention was made of the above saving clause. The contract was signed by both parties, and the boiler works entered into the work required by the agreement.

Following this, deliveries of the extractors were made, but not within the time specified by the contract, and in making payment Lewis deducted the amounts called for by the forfeiture clause in the contract for delayed delivery. The boiler works disputed the right of Lewis to make the deductions, because the delay was caused by occurrences beyond its control, and relied upon the printed saving clause noted heretofore to sustain its position.

A dispute followed which culminated in the boiler works bringing action to collect the amount that Lewis had deducted. The case reached the higher court on appeal, and here the principal question was whether or not the printed saving clause was a part of the contract.

If it was a part of the contract, the boiler works was obviously entitled to full payment without deductions for delay. If it was not a part of the contract, Lewis was entitled to make the deductions as provided for in the contract. In passing upon this question the court reasoned and found as follows:

"The primary rule in the construction of contracts is that the court must, if possible, ascertain and give effect to the mutual intention of the parties. The intention of the parties is to be deduced from the language employed by them, and the terms of the contract, when not ambiguous, are conclusive, in the absence of the averment and proof of mistake, the question being, not what intention existed in the minds of the parties, but what intention is expressed by the language used.

"The boiler works admits that after it came to an agreement with the representative of Lewis the latter dictated the terms agreed upon to a stenographer, and that no instructions were given to her to write the agreement on any particular paper. He agrees that the terms of the contract dictated to the stenographer are the same as those which appear above his signature, and that nothing was said by anybody at any time about the saving clause printed on the bottom of the white paper, although he testified that when he signed the white paper he saw the printed saving clause.

"The testimony proves that the typewritten contract fully and completely expressed the agreement between the parties, and, in the absence of any proof to show that the saving clause was left out of the contract by accident or mistake, the court cannot read this clause into it. The boiler works knew that the defendant wished to get the extractors as soon as possible, and guaranteed to deliver them by certain dates. The printed saving clause is not a part of the contract, and is inconsistent with the clearly expressed intent and agreement of the parties.

The foregoing case as reasoned by the court is in accord with the weight of authority on the question involved, this authority taking the position that the mere fact that a printed saving clause appears on paper used in writing a contract does not make it a part of the contract.

Who Makes the Profits?

In the future, according to Edward A. Filene, most of the profits will be made by those business men who substitute facts for opinions as a basis for their policies and their decisions. "Profitless prosperity"—a phrase often used to describe the condition of American business during the past few years—is not strictly accurate. There have been plenty of profits, but the large profits have been made by the few. Forty per cent of all manufacturing concerns have lost money or barely broken even. Most of the others have made but little.

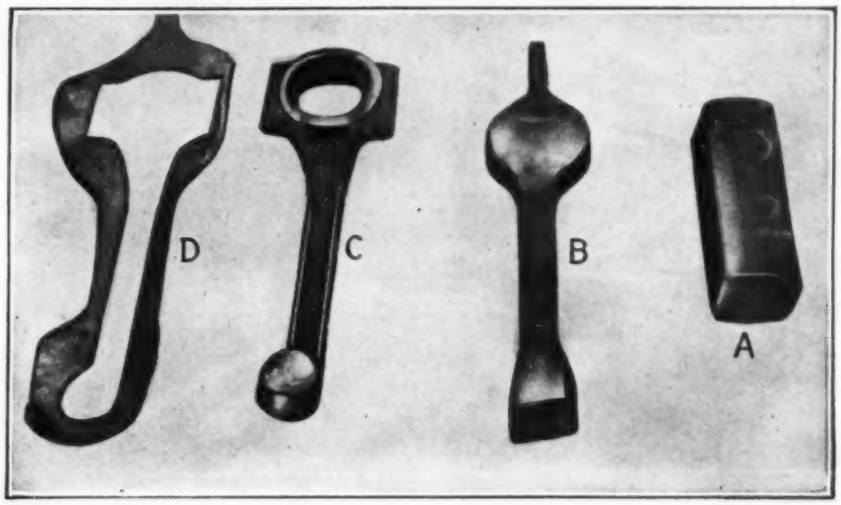
In 1925, the last year for which complete figures are available, one-fifth of one per cent of our corporations made 52 per cent of the total profit. For each dollar made by these large and successful companies, some less well managed concern lost 22 cents.

Even more striking is the fact that 95 manufacturing corporations—only one-fiftieth of one per cent of the whole—made 45.5 per cent of all the profits in their particular branches of industry.

More recent figures, while incomplete, indicate that the lion's share of the profits is still going to the large scientifically organized businesses.

It is generally agreed by thoughtful business men that this trend will become more pronounced and that the most profitable concerns will be those which adopt scientific methods of mass production and mass distribution.

Fig. 1 — The connecting rod forgings. Owing to the cost of the nickel steel used in the connecting rods, great care is taken to reduce the weight of the forging to the minimum.



The bar stock is cut cold under a drop hammer as nearly to weight as possible, as shown at A. The other stages are shown at B, C and D

Connecting-Rod Methods
in the Lancia Plant

By J. A. Lucas

THE evolution of the Lancia connecting rod from the blank at *A*, Fig. 1, shows the principal stages through which it passes. The blank is first cut quite accurately so as to avoid waste of stock. It is then rough forged under an air hammer until it assumes the shape at *B*. The completed forging, after the flash has been trimmed, is shown at *C*, the flash itself being at *D*. The forging is done at about 1,920 deg. F., and great care taken to secure uniformity in weight, the desired tolerance being about $\frac{1}{16}$ oz. The forging is then heat-treated at a temperature of 1,560 F., quenched in oil at 185 F., and drawn at about 1,110 F. This procedure gives the rod a tensile strength of between 125,000 and 130,000 lb. per sq.in. The average scrap is from three to five per cent. The offset on the connecting rod is because of the inclined cylinders.

After the usual visual inspection, the rod goes to the simple milling operation shown in Fig. 2, where two reference surfaces are milled as locating points for future operations. The rod is supported by the crankpin boss on two steel plugs, one of which is shown at *A*. It will be noted that the base of the fixture is provided with numerous holes in which these supporting plugs can be placed, so as to accommodate rods of varying sizes.

The three-spindle drilling machine shown in Fig. 3 performs three separate operations, but which are not in sequence. The central spindle first rough drills the piston-pin hole. Details of the holding fixture are shown in Fig. 4, which shows how the rod is supported on shouldered studs *A* and clamped. The hole is reamed in this position. The construction of this fixture is shown in Fig. 12.

Using the piston-pin holes as guides, the rods are located on the fixture, shown in Fig. 5, where the upper sides of the bolt bosses are on one side surfaced and the caps are slit. The fixture holds four rods. The caps from two of the rods shown have been removed. This operation requires four minutes.

The surfaces for the caps are then ground on a Pratt & Whitney machine, Fig. 6, the rods being located by the pin- and bolt-bosses. The grinding requires two minutes for the eight rods. The bolt holes in the rods are then drilled in the fixture shown in Fig. 7, which holds four rods. The rods are located by the piston-pin holes, while the bolt bosses rest on the blocks *A*, as in the grinding.

In the meantime, the caps are being drilled in the fixture shown in Fig. 8. They are located by stationary V-blocks in the center and are held by adjustable V-blocks, as at *A*. Straps *B* draw the two caps up against the plate carrying the drill bushings. Both caps and rods are then assembled in the fixture, Fig. 9, and the bolt holes are hand reamed so as to insure alignment and a satisfactory check for the bolts, which are ground on the body and held to a small tolerance. The heads of

The first part of the article. The conclusion will appear in an early issue.

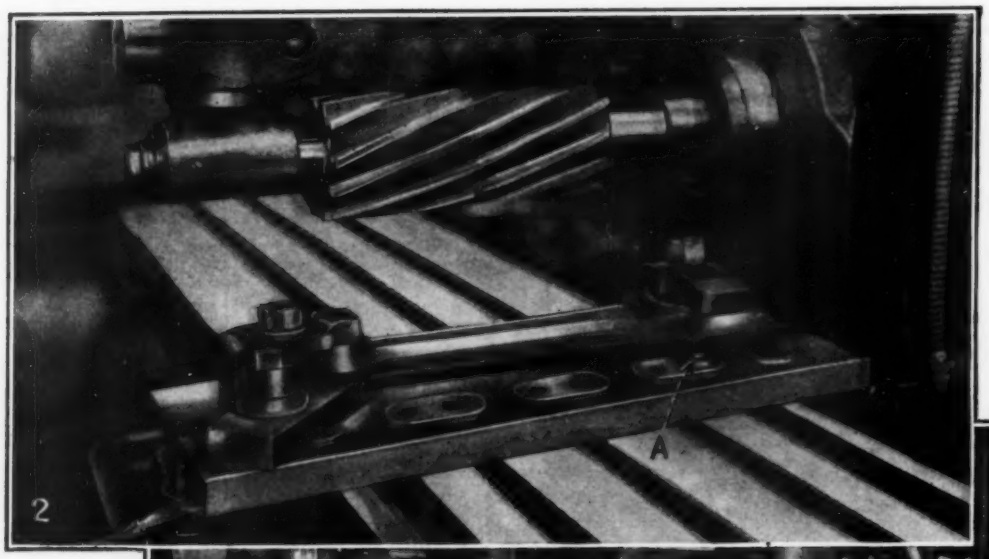


Fig. 2 — Milling locating points for future operations. The forgings are supported on steel buttons, as shown at A, which can be placed in any of the holes in the base to accommodate forgings of different sizes

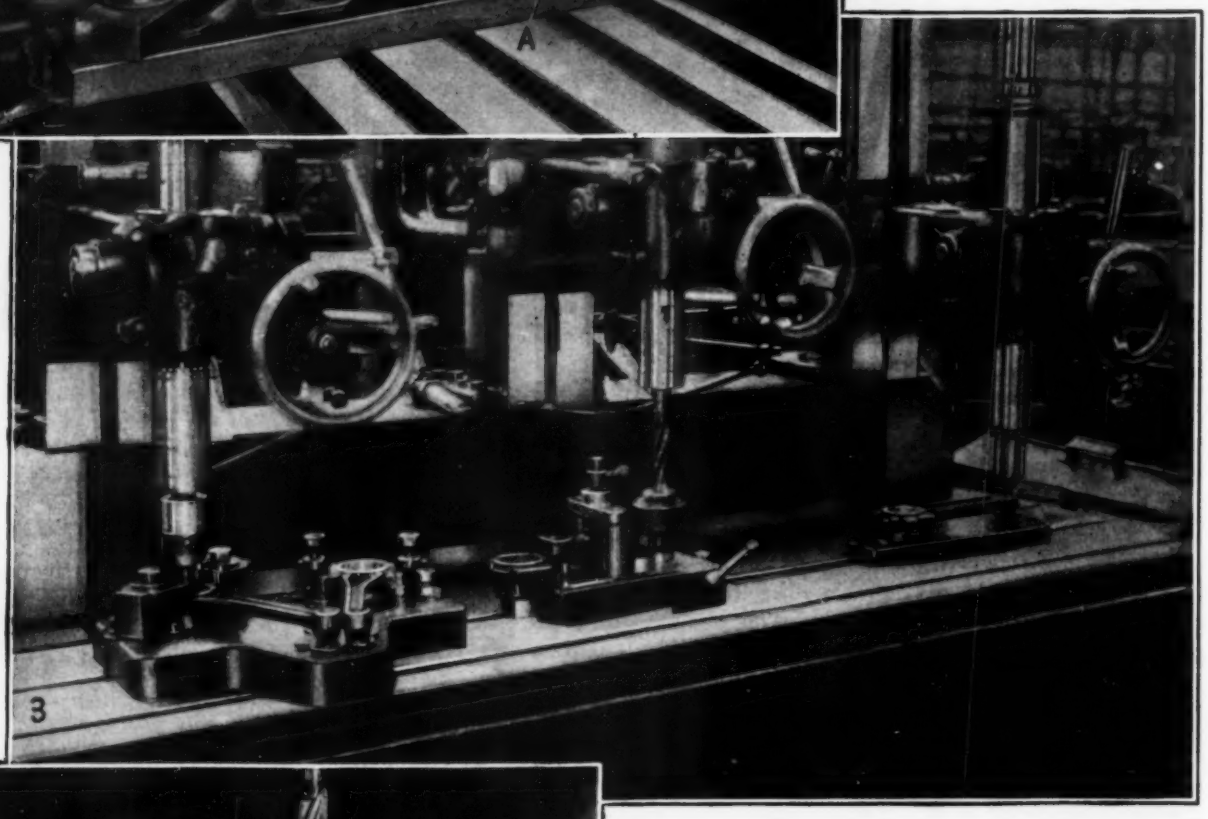


Fig. 3—Boring, drilling and countersinking the ends. The three-spindle machine handles the three operations, but different fixtures are used under each spindle. Details of one of these fixtures are shown in the previous illustration

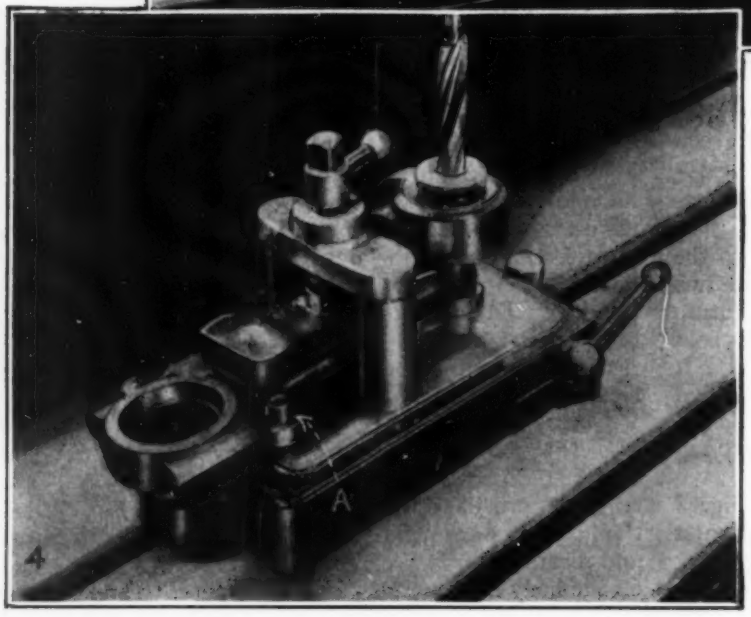


Fig. 4 — Fixture used in drilling piston-pin hole in small end. This view shows how the connecting rod rests on the previously milled surfaces, and how it is clamped close to the end being drilled

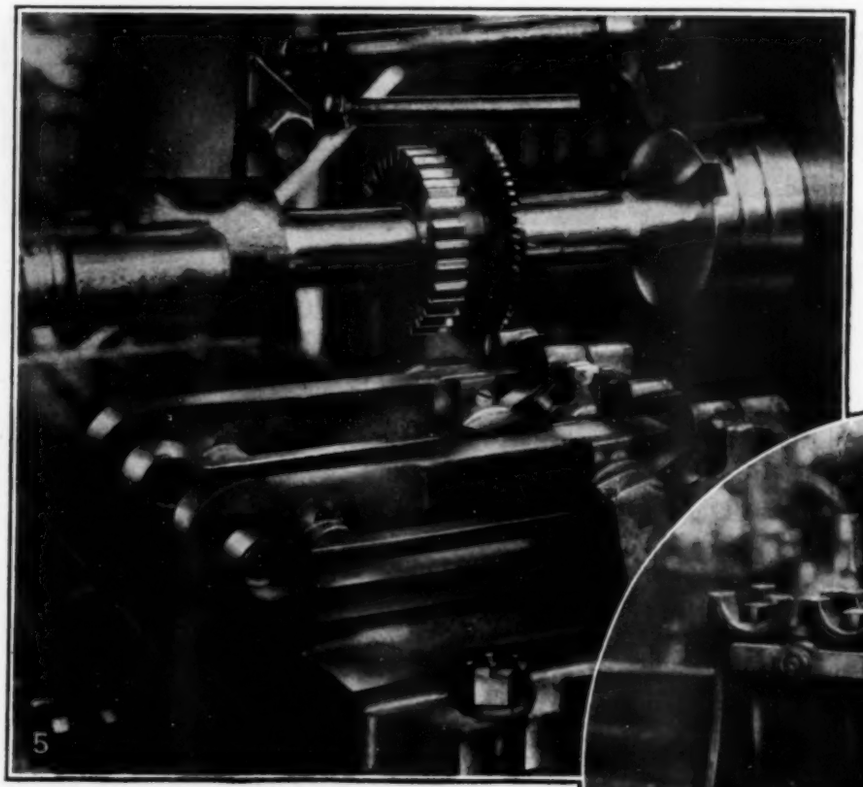


Fig. 5 — Milling bolt bosses and slitting one side of the cap. The rods are located by the holes in the small ends and are clamped against steel strips as shown. Four rods are milled on one side at each pass of the milling cutters

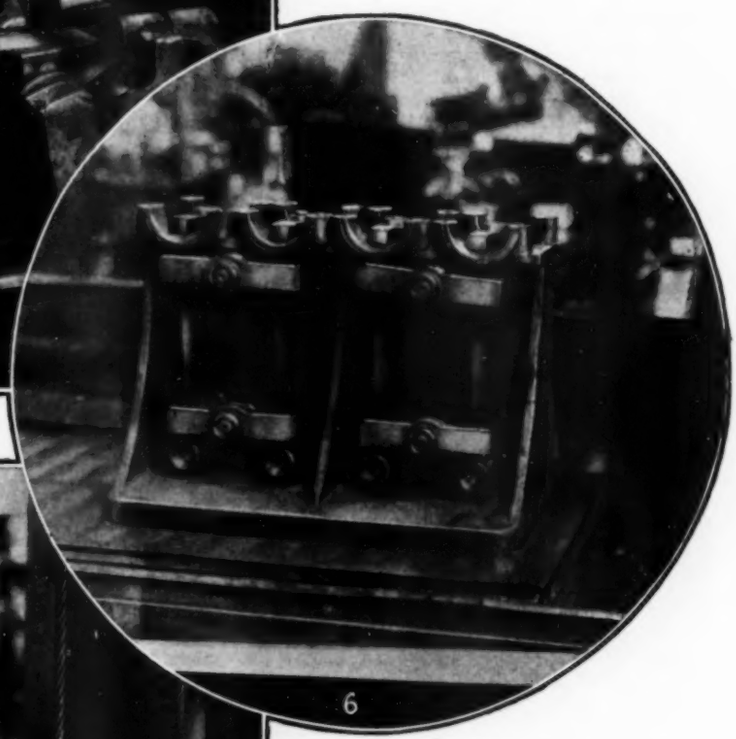


Fig. 6—Grinding the surfaces for the caps. The rods are again located by the pin hole and the bolt surfaces in a fixture holding eight rods. The fixture is held on a magnetic chuck and the surfaces are ground in a vertical spindle machine

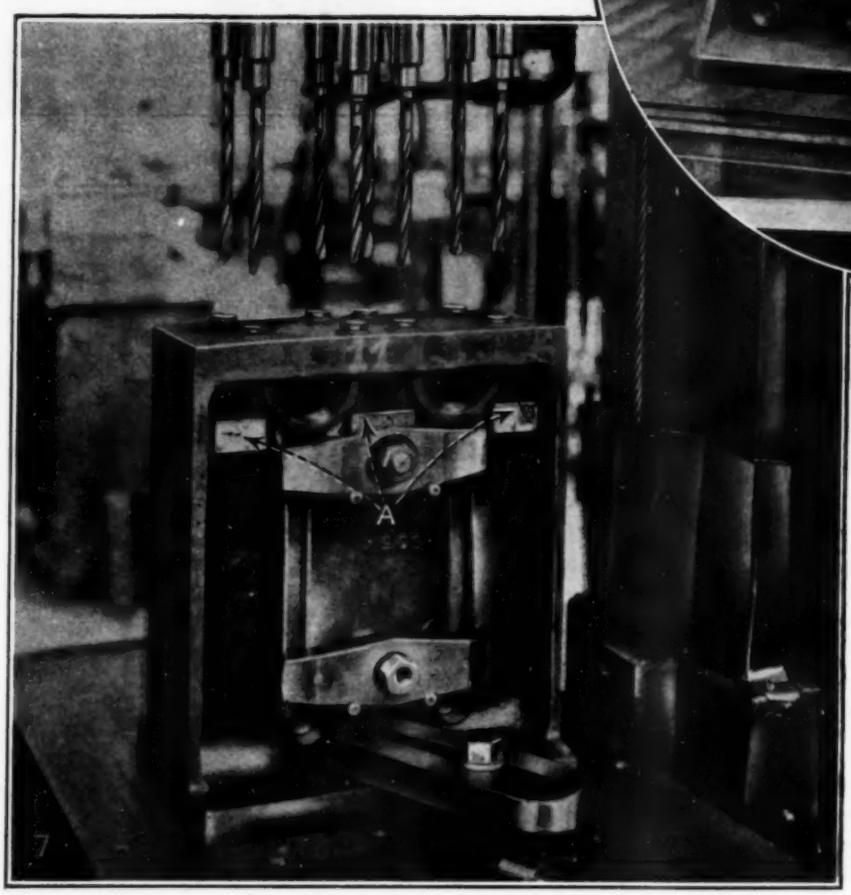


Fig. 7—Drilling the bolt holes. This fixture is double and holds two rods on each side. The rods are located both by the piston-pin holes and the bolting surfaces that were milled in the slitting operation

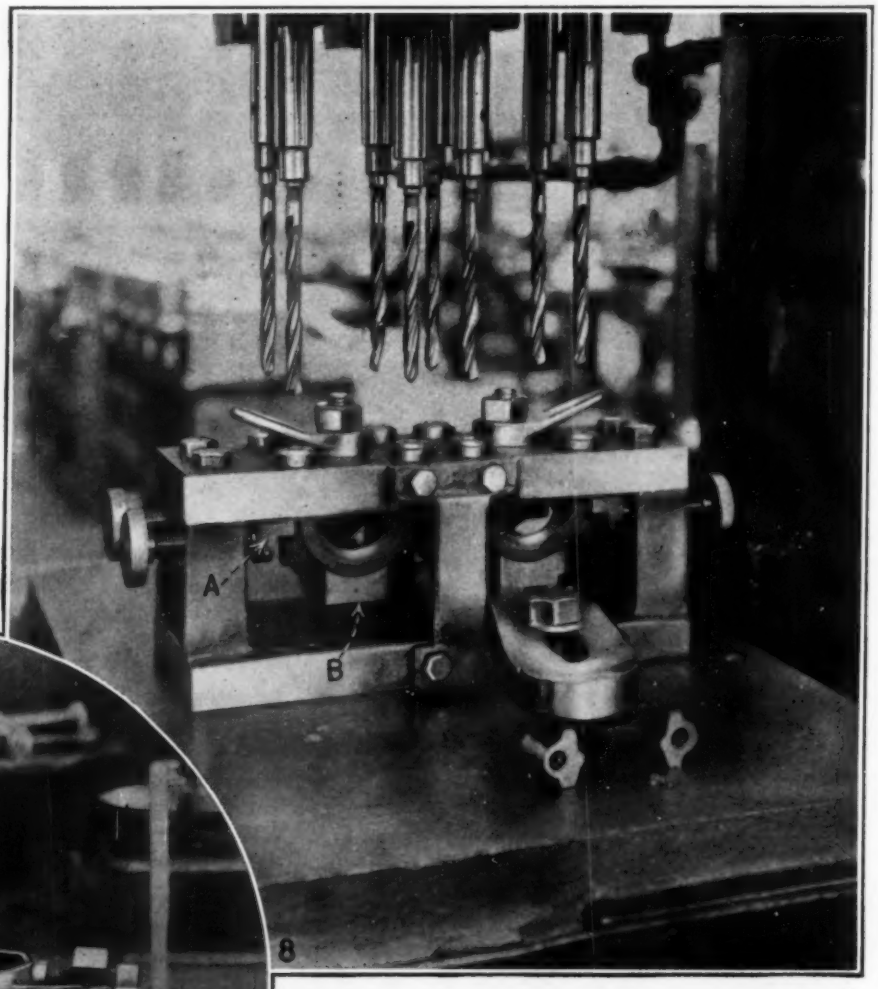
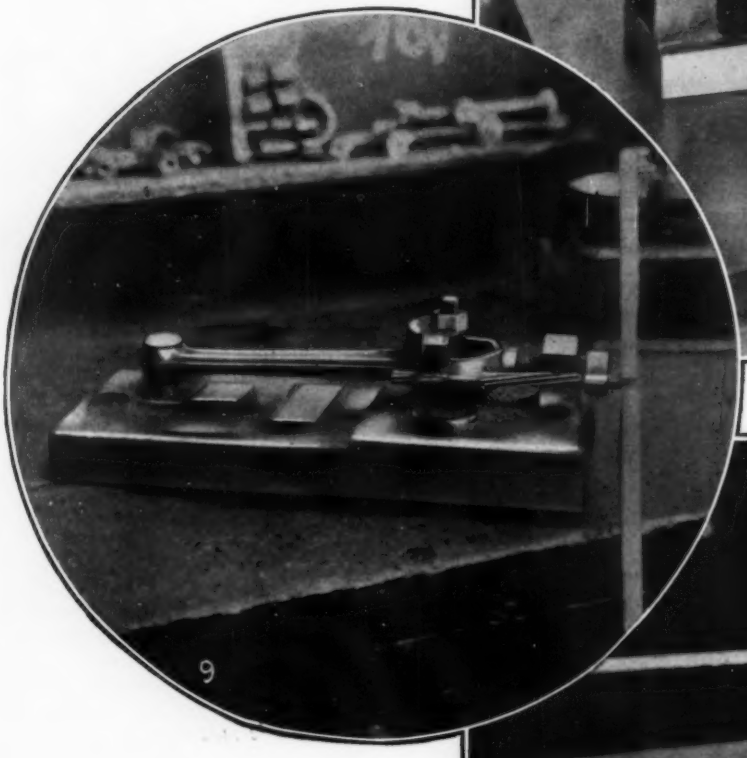


Fig. 8—Drilling the caps. The caps are drilled in the fixture shown, four being held at once. The caps are drawn up against the bushing plate by a clamp operated by a central bolt and are held by adjustable V-blocks operated by knurled screws

Fig. 9 — Hand reaming bolt holes of assembled rod and cap. The rod is clamped to the fixture shown, and the cap is held in position by an outside screw. The bolt holes are then hand reamed to insure alignment



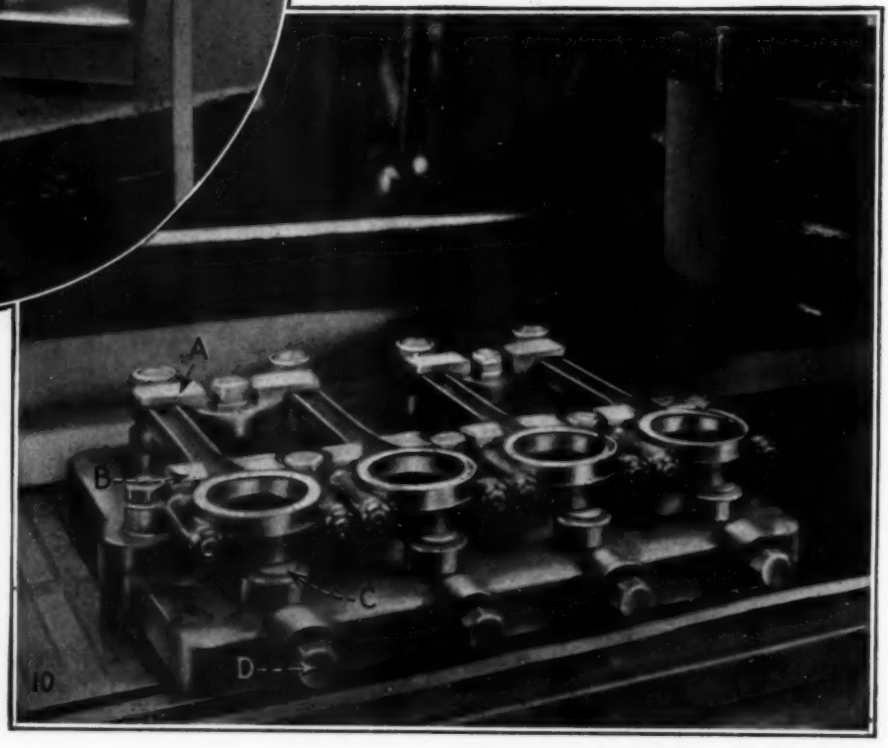


Fig. 10 — Grinding the sides of the bearing bosses. The fixture holds four rods with the caps in place. The rods are positioned from the small holes and the large ends are supported by pins

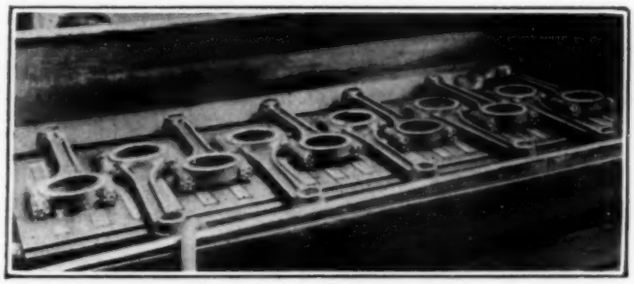


Fig. 11—Grinding the reverse sides of the large ends. Here the rods are held in a magnetic chuck that holds eleven rods while the second sides of the large ends are being ground parallel with the sides ground in the preceding operation

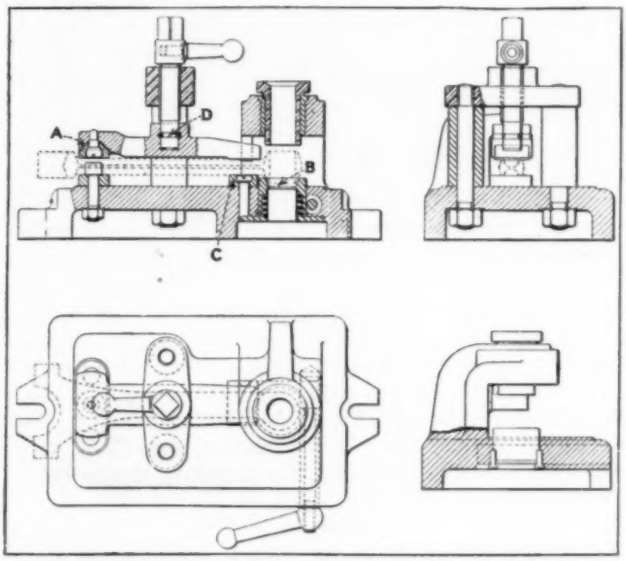


Fig. 12—Fixture for holding connecting rods for drilling. The special features are the swivelling jaw at A and the floating bushing B that centers one end of the rod

the bolts are also ground, so as to permit the use of a close-fitting wrench.

The Pratt & Whitney grinder again comes into play for finishing the sides of the large ends of the rod, as in Fig. 10. The small ends fit over locating pins and are supported directly beneath clamps, as at *A*. The rods are also clamped at the large ends, as at *B*, but not until the ends have been firmly supported by the pins *C*. These pins have springs underneath that force them up against the rough surfaces of the forgings, at a pressure great enough only to insure perfect seating. The pins are then locked in position by the screws *D*, and the clamps *B* are drawn down sufficiently to hold the rods firmly while they are being ground. This operation requires three minutes. The rods are then reversed as in Fig. 11, and are held by the magnetic chuck on the surface previously ground. This chuck holds eleven rods, which are ground in one minute. The saving in time is due to the magnetic chuck avoiding the necessity for individual clamping.

Details of the fixture that holds the connecting rod are shown in Fig. 12, one distinguishing feature being the ball or swivelling button at *A*, which adjusts itself to any irregularity in the rod forging. Another feature of this fixture is the self-centering bushing at *B*, which locates the rod in the fixture. This coned bushing is supported by a spring that always permits the rod to rest on the hardened block *C*. The clamping screw is held in the strap by two pins that fit into the groove at *D* and permit free turning while lifting the strap when releasing the work.

Broaching Round Holes

BROACHING, as a means of finishing round holes, is a subject on which many good mechanics differ widely. Whether it be either the large or small end of connecting rods, valve stem or valve lifter guides, or a dozen other round-hole operations, the method has ardent advocates and equally positive opponents. And both sides seem to be able to point to excellent examples to bear out their contentions.

One broach expert shows an excellent hole in both the large and small ends of a connecting rod, one hole is in bronze and the other in babbitt. Both are very smooth and presumably round and straight. He shows a broach with practically no land between the teeth—no space that is more than a mere departure from a sharp edge—and he assures us that such a broach cuts more nearly round and straight than any other. Further, he names a length of service that hardly seems possible. An occasional burnishing of the cutting edge with a glass-hard tool restores any very slight decrease in size, due to wear.

This man has no use for burnishing collars or buttons, claiming that their use distorts the metal around the hole being broached and that it changes shape after the broach is removed. This he claims is particularly true where the bushing is confined where the surrounding metal is not uniform, as in the small end of a connecting rod. Here, it is claimed, the burnisher springs the metal around two-thirds of the bushing, and that the bushing closes in, unequally of course, when the broach is removed, leaving a hole that is out of round.

The fact that comparatively few small-end or piston-pin bushings are now finished with burnishing broaches indicates that his contentions may be sound. On the other hand, comparatively few are now finished with broaches of any type, being reamed or bored with a single-point tool, even on engines of the less costly type. All builders seem to have discovered that the more nearly round the pins and the holes in which they bear, the longer the life and the more satisfactory the performance of the engine.

Another factor in considering the broaching of holes where extreme accuracy is required is that of perfect alignment of the broach during the cutting operations. In horizontal broaching the sag of a long broach must be reckoned with and counteracted. And with the shorter broach used in vertical push-broaching work, there is some possibility of the broach being canted slightly to one side. Here again, however, we are confronted with the fact that both types are used in finishing holes that seem to give good satisfaction in use.

If you want nickel plating to stick on steel, there must be a good coating of copper deposited under the nickel.

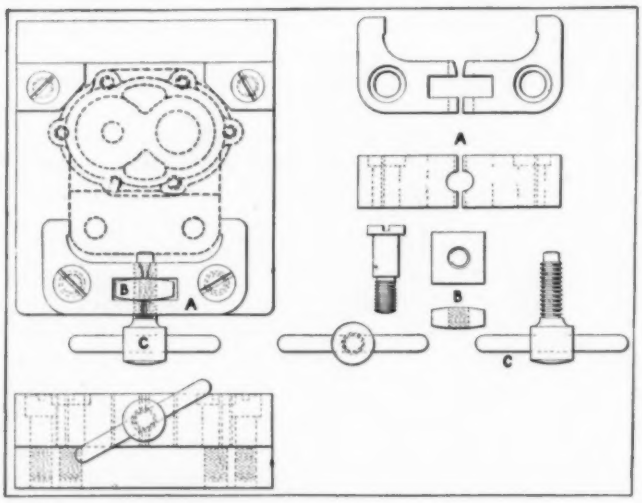
IDEAS · FROM · PRACTICAL · MEN

The department, "Ideas from Practical Men," is devoted to the exchange of information on methods useful to the machinery industries. Its scope includes all divisions of the metal-working industry, from drafting room to shipping platform. Descriptions of methods or devices that have proved their value are carefully considered, and those published are paid for. The rates are from a minimum of five dollars upwards, depending upon their merit

An Equalizing Clamp for a Jig

By Andrew Meldgaard

The work indicated by dotted lines in the illustration was centered at one end by contact with the two angle blocks in the corners. For holding and centering the opposite end, the equalizing clamp *A* was made. The clamp is in two parts in the shape of bell cranks, each of which is pivoted on a screw, as shown. In each part



An equalizing clamp

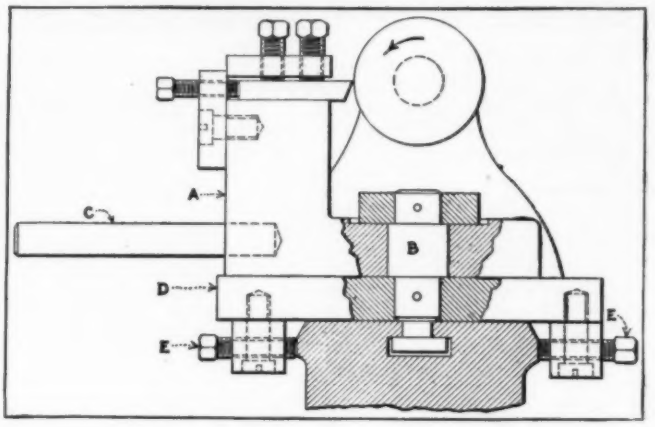
is a slot to accommodate the nut *B*, in which fits the clamping screw *C*.

In operation, the clamping screw is turned until its end contacts with the work. Further turning in the same direction draws back the nut and causes the gripping ends of the equalizing clamp to grip the sides of the work, centralizing and holding it and at the same time forcing it against the angle blocks. Details of the clamp and its parts are shown at the right in the illustration.

Tools for Turning Balls in the Drill Press—*Discussion*

By Charles S. Hazard

The combination of tools for turning balls described by Jim Henderson on page 667, Vol. 67, of the *American Machinist* is ingenious, but will not produce satisfactory work where accuracy and good finish are required. The reason is that the successive cuts of the tool bits on the surface of the ball are not parallel, and hence the depth of the cut varies from point to point. Even though the ball be rotated at a uniform rate, this condition will cause inequalities in the size and the finish.



Ball-turning device for a bench lathe

The sketch herewith shows a tool that we have found entirely satisfactory for this class of work, and which certainly costs no more to build than Mr. Henderson's. It is mounted on a bench-lathe, the work being held in a suitable collet. The toolpost *A* swings on the stud *B*, being fed by the lever *C*. The mounting-plate *D* is provided with adjusting screws *E* for centering the toolpost with the lathe spindle.

Cutting a Rack for a 50-Ft. Interferometer

By John Homewood

An instrument now under construction on Mount Wilson, is the 50-ft. interferometer for use in measuring the diameters of celestial bodies. The instrument is rather large and when in operation will be out in the open. When not in use the instrument will be covered by the movable building shown in Fig. 1. The upper part of the building is of structural steel, covered with corrupated iron, and is provided with a large raising door so as to clear the instrument as the building is run out on the tracks shown in the illustration. Two long, steel

Fig. 1—Interferometer house and track

racks of 3 diametral pitch and driven by pinions, are used to move the building back and forth. The length of the racks made it necessary to resort to an unusual method of cutting the teeth.

At the laboratory shops in Pasadena a special rail and a milling head, Fig. 2, were made for a Lucas horizontal

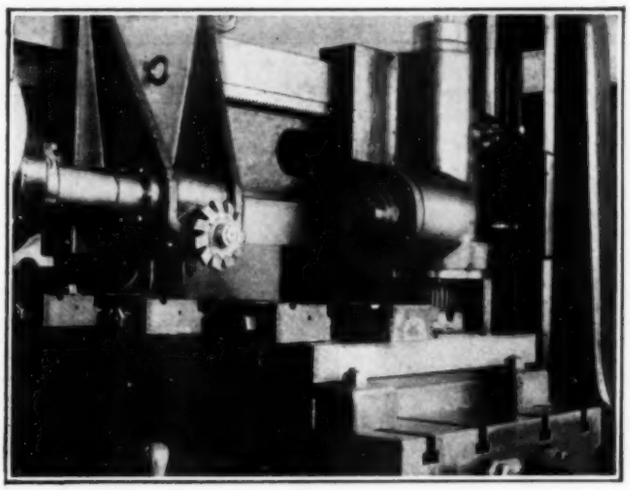


Fig. 2—Rack-cutting attachment on horizontal boring mill

boring mill. The lengths of the rack sections were: two, 11 ft. long; and sixteen, 9 ft. long. A casting 30 in. long, drilled and counterbored for hold-down screws, was cut out step fashion for supporting the rack blanks. In this casting was set a pin for locating purposes. Three clamping blocks, drilled and counterbored for clamping and hold-down screws, were used for gripping the blanks.

Before a blank was inserted in the fixture, the gear cutter was run over the pin, just taking a skimming cut. The blank was then inserted and the teeth were cut as far as the travel of the cross slide would permit. It was necessary to shift the blank for further cutting, and it was relocated by setting a ground pin in the last space cut, and sliding the job along until the pin came in contact with the pin in the holding fixture. This process was repeated until the full length was cut.

Floating Bushings for Center Cranks

By Clifford H. French

Floating bushings are growing in favor for the large ends of main connecting rods. One of the latest applications is on the large, center rod of 3-cylinder locomotives. These bearings are large, inaccessibly located and, presumably from lack of sufficient or proper lubrication, they could not be depended on for fast passenger service where speeds of over 60 m.p.h. is needed at times. The use of the floating bushing has solved the problem.

As it is necessary to have an open-end rod and a sectional bushing in order to get the bushing in place on the center crankpin, the old rod is used by making a special strap as shown. This is forged in such shape as to hold the bushing and is flanged, as at *A*, Fig. 1, so as to support the bushing the whole length of the crankpin. A special block, *B*, Fig. 2, supports the other side of the bushing, the hole or bearing for it being ground when the rod and strap are assembled. They are, of course, disassembled to put in place on the pin.

The bushing is made in three parts, as in Fig. 3, being

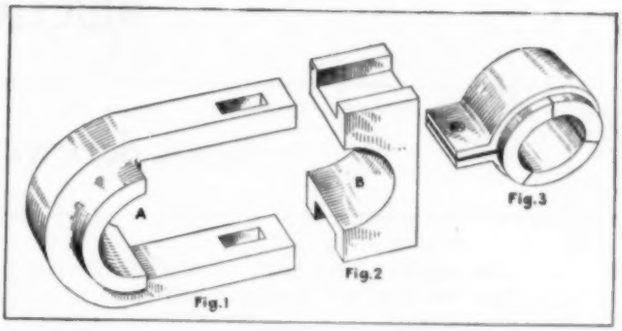


Fig. 1—New strap for use with floating bushing. Fig. 2—Filling piece that forms the back bearing. Fig. 3—The three-piece bushing and its clamp

tacked together at the joints and held in a clamp while being handled in the shop. With the clamp in place it is put on the boring mill table and chucked. The clamp is removed and the bushing is bored through and turned for something over half its length. The clamp is again put on, the bushing is turned over, rechucked and the other end is turned. When finished it is separated by tapping the joints with a hammer. It is drilled and countersunk for lubrication in the usual way.

Sizes of Bosses and Depths to be Tapped for Pipe Work

By LeRoy Coon

The chart shown in the illustration is a time saver for the draftsman when the sizes of bosses for pipe work are limited, and where the thickness of material is essential to obtain tight threads.

With the chart, the dimensions can be seen at a glance, and the sizes can be transferred to the drawing with a

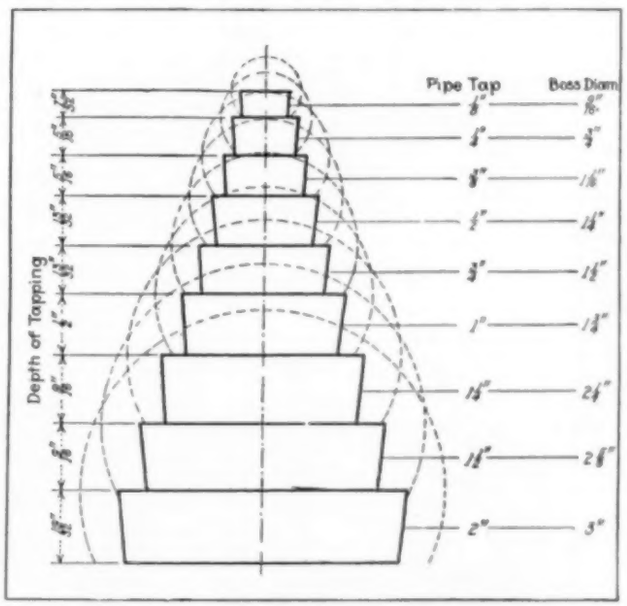


Chart for laying out work to be tapped for pipe

pair of dividers. If the drawing is being made on thin paper, the sizes wanted can be traced by putting the chart under the paper. In such cases the chart would have to be made to the same scale as the drawing.

Lock Screws and Pressure Plugs

The pressure plug, or pad, applied between a holding screw and the part upon which it bears, is a machine and tool detail that deserves a wider application than it has, since when properly made it avoids marring the piece held, and eliminates later trouble in closely fitting parts. In many instances it is possible by its use to equal the holding power of a bare screw, and in others, as in hardened cylindrical parts, to exceed it or to avoid the necessity of resorting to flats or spots on the part to be held. In tool design, a screw actuating a pressure pin can often be substituted for other clamping means, which would be more expensive or troublesome to apply, and permits separate or simultaneous longitudinal and circumferential adjustment to close limits.

In the question of design, it may be observed that ordinarily it is best to make the pressure pin or plug a snug sliding fit in its hole, to prevent it from turning and dropping. Where possible, its length should equal or exceed its diameter. The end which takes the screw point should never be left square, as in the center of Fig. 1, but beveled at about 60 deg., included angle, as shown at the right, to prevent the top mushrooming and wedging in the thread. Neither a pointed screw nor the low, flat bevel at the left will be any safeguard against trouble from this source, unless the pressure element is of hardened steel.

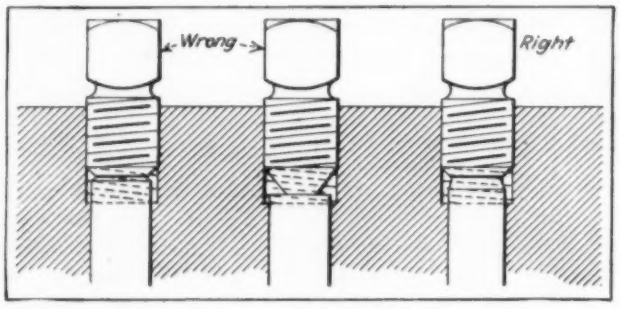
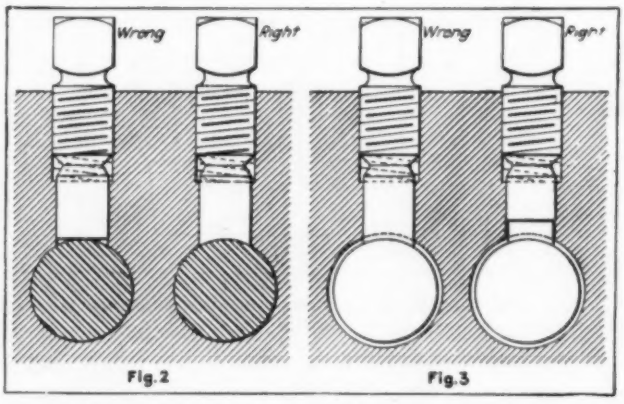


Fig. 1—Bearing points for set screws



Figs. 2-3—Methods of seating pressure plugs

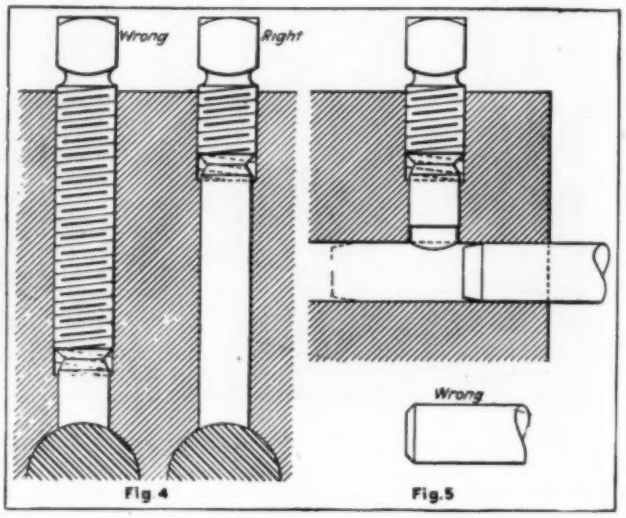


Fig. 4—Set screw for long reaches. Fig. 5—Correct end bevel for removable part

A pressure pin made and used like the one at the left of Fig. 2, is as bad as the setscrew used direct, since the flat point can only make a line contact on the cylindrical part. The end of the plug should always be made to conform to the radius of the piece to be clamped.

Where the point of the plug enters a free space around the part being held, as in Fig. 3, the plug just designated as being "right" would be considered bad unless it were hardened. The tendency of the soft end to spread would be likely to cause trouble in removal, unless it could be knocked out through an opposite hole. Here the plug should be slightly turned down at the end as shown at the right. This precaution is, in fact, one that it will pay to apply in *all* cases, especially where occasional slippage under pressure of the part being held must be expected.

In Fig. 4 is shown the wrong and the right way of applying a pressure pin, where a considerable thickness of metal in the outer part must be traversed. The method illustrated at the right gives the same pressure at less expenditure of work, and the pin is easily removed. A long pin of this kind should never be made a tight fit all over. A much better way is to make the pin a fairly loose fit, and then spring it slightly to supply a frictional hold.

Some parts call for frequent removal and replacement. In such a case, it would be a mistake to bevel the end of the part to be held as shown at the right of Fig. 5, as it would have a tendency to shear and wear away the front end of the gripping surface of the plug.

(Continued on Sheet 17a)

Submitted by Henry Simon, Jena, Germany

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· TECHNICAL · ABSTRACTS ·

Cost Versus Means of Heat Treating

Much has been written on the comparative cost of fuels and electricity for heat treating, but it isn't the fuel cost so much as the final cost that is of interest to us. By final costs we mean to take into consideration the cost of the tool, the work produced by it, and the cost of producing the work, as well as the initial cost of the actual heating.

It is the application or method of applying the heat that is the most important factor. That method which gives the greatest degree of uniformity in heating and is most closely controlled increases the life and consequent production of the tool, and hence will generally prove to be the most economical.—*Heat Treating and Forging*, January.

Hydraulic Feeds for Machine Tools

Within the last few years many standard machine tools have been designed with hydraulic feed mechanisms built in as a part of the machine. About the first to be so equipped were broaching machines. The productive capacity, flexibility, and low maintenance cost of these machines attracted the attention of many machine tool builders and users. Later, grinding machines and drilling machines were sucessfully equipped with hydraulic feeds.

Although the basic principle of hydraulic operation of feeds and drives appears simple, the actual development of a practical system involves considerable engineering. The requirements of one machine may be met by comparatively simple equipment while another may demand a system much more elaborate. Both high and low pressure systems are used, depending upon the requirements of the machine.

At present there are three types of pumps in general use: an accurately made gear pump delivering a constant volume of oil at a constant pressure; a multiple-piston pump with variable stroke; and a pump which combines the first and second types, arranged to deliver a large volume of oil at a comparatively low pressure from the gear pump and a smaller volume at much higher pressure from the variable-delivery piston pump.—*Machinery*, February.

New Specifications for Raw Materials

The Western Electric Company, the Northern Electric Company, the American Brass Company, and the Bell Telephone Laboratories co-operated in an investigation that led up to new specifications for non-ferrous sheet metal. These materials must be capable of fabrication into apparatus parts having resistance to wear, bending, torsion, vibration, corrosion, etc. A complete tensile test will give many of the essential mechanical properties but leaves much to be desired for the inspection of raw materials. The method of attack on the problem of non-ferrous metals was to have the brass companies prepare sample lots rolled to various thicknesses and hardnesses. Complete physical tests made on these samples in the laboratories showed that the scleroscope test of hardness as formerly specified did not give sufficiently precise results when used under inspection conditions. A close agreement, however, was found between the Rockwell hardness numbers and tensile strength. Furthermore, Rockwell hardness numbers as determined on five different instruments showed that the various inspection results of producer and consumer could be expected to agree.

In the new specifications drawn up as the result of these tests the tensile test is given as the basic test and the Rockwell hardness test is used for inspection since it is not destructive and easy to apply. The tensile test is used only where there is doubt about the ability of the material to fulfill the requirements. The Rockwell test is specified for all thicknesses of sheet brass down to 0.0020 inches. For thinner material the tensile test is always made.—J. R. Townsend in *The Bell Laboratories Record* for February.

Must We Limit Production?

Because of the fact that materials purchased during a period of falling prices deteriorate so much in value during the manufacturing process, thus often eliminating the expected profits on the merchandise, business usually marks time during a slumping commodity market. For some reason the present period seems to be an exception to the general rule. One reason is that factory managers by increasing the output per man per machine or per factory have made it possible to absorb the higher costs of labor and equipment. The achievements of the factory managers in increasing the efficiency of production have been so considerable that the increased output per unit not only absorbs the higher manufacturing cost but what is more important, it has also been absorbing much of the increased cost of distribution as well. But in solving the manufacturing or production problem, we have run into the problem of finding an outlet for more merchandise than we have yet been able to sell at a profit.

Apparently the only way business can avoid the Scylla of too much production on the one hand and the Charybdis of too much distribution cost on the other is to establish a better correlation between these two essential functions of a manufacturing enterprise. It is only in this manner that congestion can be removed from the channels of distribution. To make possible such an even flow of goods, it goes without saying that the manufacturer must not overproduce. If there is a proper correlation between his output and his consumer sales, his production has to be gaged to achieve this balance. That is where many manufacturers lose courage. It is so easy to produce with modern machinery that it takes nerve to regulate this production.—Thomas C. Sheehan in *The Magazine of Business* for February.

How Much Power Will Ball Bearings Save on Line Shafts?

Some years ago efforts were begun to apply some type of ball or roller bearings to lineshafts. In most of these earlier installations a fairly long roller was employed. Power tests, although satisfactory when the shafting was first lined up and leveled, were disappointing a few months later when the usual misalignment occurred.

Both ball and roller bearing units for lineshafts and for line shaftings have been highly developed since that day, however, and the better types of each now offer positive power saving. This saving in power can be absolutely demonstrated by test, and the amount reduced to horsepower, kilowatts or dollars and cents.

It sometimes happens that tests show almost no apparent power saving with anti-friction bearings although all of the conditions indicate that the savings are there. It has been found that this is generally due to the motor's having been overloaded when plain bearings were used. When ball bearings were installed the motor speeded up to normal and the power saving was shown in increased production as the result of speeding up the machines rather than in kilowatts. Ball bearings are frequently installed primarily to eliminate breakdowns of other bearings due to dirt, heavy loads, high speeds, and severe service conditions with power saving as incidental. Head shafts and heavily loaded jack shafts are examples of such an application. Saving in maintenance is also an important factor where there are many bearings.

A summary of approximately ninety tests taken in about twenty-five industries during the past three or four years on ball-bearing hanger boxes shows an annual average return on the investment of 66 per cent in direct savings of power, oil, and labor. This leaves out of consideration entirely the indirect savings many of which, such as continuous operation, will outweigh even power saving in the profits they can show.—H. R. Reynolds, *Industrial Engineering*, February.

American Machinist

Editors: KENNETH H. CONDIT AND FRED H. COLVIN

Established 1877

Strides in Foreman Training

FOREMANSHIP training is growing by leaps and bounds. The number of courses in American industrial plants was 933 during the year 1927, as compared with only 105 during 1925. Foreman training is now generally considered as one of the most important factors in management, for it is recognized that the foreman in any large plant usually represents the management in the eyes of the workman. He is the important link connecting management and the workmen, and if he fails in his job of directing labor properly, incalculable harm may result to the organization.

Less than a century ago it was the customary practice in the Lancashire mills for the foreman to carry a strap which he laid with emphasis across the shoulders of any child worker who did not keep up with the rest. It was little above the foremanship that was used in building the pyramids. In effect, therefore, the industrial world has advanced more in the last hundred years in management methods than it had in the forty preceding centuries. But this does not mean that it has reached the ultimate in efficiency in industrial relations. It means rather that methods are improving in something like geometric progression, and that to keep up with the competition of the new generation those men already in foremen's positions must be alive to the latest methods in management. It is safe to say that the next ten years will show greater strides in foremanship than the last ten, and one of the best ways for the foreman to keep ahead of the times is through the foremanship courses that are offered by progressive plants.

More Servicing Will Be Required

TO HENRY FORD is attributed the statement that men lose their usefulness when they become mentally inflexible. Such being the case it will be well worth while for executives in equipment building organizations to examine the spirit of themselves and their men to make sure they are not inflexible in the face of changing trends.

Take, for instance, the amount of servicing of machinery in use required by the customer. In the days when machines were relatively simple and the operator was relatively skillful almost no servicing was asked. To offer it would have been an insult to the man whose pride it was to keep his machine in first class order. Today, on the contrary, the machine is far more complicated and the operator proportionately less skilled. In other words, the skill of the designer and maker has been transferred to the machine and consequently a much lower grade of operator is needed.

It follows, therefore, that much less in the way of care and adjusting can be expected from the operator and that servicing must be done by a specialist either in the employ of the customer or else sent out by the builder of the equipment. The more complicated the machine the more likely it becomes that the best results will be secured by having the servicing done by an expert from the builder's organization. No matter how efficient the service crew of the user may be the chances are against their being acquainted with all the little peculiarities of the many different types and kinds of machines in a modern plant.

Nothing will be gained by resisting so general a trend toward the requirement of more servicing from the equipment builder. The thing to do is to recognize it, organize to take care of it, and get a fair price for it either in the original selling price of the equipment or as a direct charge.

Courtesy in Receiving Visitors

COURTESY in contacts with the visitors and possible customers of any organization is a great asset. Just how great it is difficult to determine, but its value is being recognized by all progressive plant managements. In view of the almost universal courtesy that is to be found in well managed plants in all parts of the country, it is both surprising and exasperating to find offices where even common civility is missing. Reception rooms, so-called by courtesy, that are bleak and devoid of easy chairs, or seats of any kind, are still to be found, and manned by men who know nothing of meeting people in a way to make them feel friendly toward the firm.

No concern is either too large or too small to consider carefully its manner of receiving visitors and customers. Cheerfulness, both in the room and in the personality of the clerk in charge, is important and should be so considered. Answers to telephone calls come under the same category. The voice with the smile wins—as the telephone company so aptly puts it.

Moline Nos. 13 and 10-D Hydraulic Feed Cylinder Borers

TWO sizes of hydraulic feed cylinder boring machines, having many radical improvements, were recently placed on the market by the Moline Tool Company, Moline, Ill. Both machines employ the Oilgear equipment for furnishing the hydraulic feed.

The No. 13 machine, Fig. 1, is the larger of the two, and is particularly recommended for heavy roughing operations, the machine being rigid enough so that piloting of the boring bars at either top or bottom is not necessary, although this can be done, if desired. The column or housing is of large box section and extends down to the floor and is bolted to the base. The head is properly counterbalanced, all weights being placed inside the column.

In Fig. 2 is shown a cross-section of the slide and column featuring the double V-guide, commonly used in other types of machine tools. With the hydraulic feed cylinder mounted central between the two guides, any possibility of the slide weaving during heavy cuts is eliminated. The slide is securely held against the V-guides by four taper gibs, which are advanced toward one another by screw adjustment. Antifriction bearings are used in all drive shafts, including the main spirals.

The main drive is either direct by motor as shown in Fig. 1, or from a countershaft. A belt tightener mounted on radial bearings is then provided. From the main drive shaft, the power is transmitted to the hardened spiral drive shaft through spur gears, which are also hardened.

The sides of the spindle housings or heads, are accurately scraped and furnished with the necessary spacers so that all the heads can be bolted together to the desired position, giving the effect of a solid-group spindle head, yet permitting quick changing for different spacings. The spindles are mounted in Timken tapered roller bearings of the precision type, provided with adjustment for wear. Special bronze spiral gears mounted on the spindles mesh with the main driving spiral and the entire assembly is flooded with oil through a force-feed circulating system. The oil is drained at both the top and bottom bearings to insure against leakage around the spindles.

The same motor used for the spiral drive is also used to drive the Oilgear pump. The entire control of the feed cycle is automatic. The operator has only to shift the starting lever, and the rail on which the spindles are mounted is brought down rapidly to the cutting position, whereupon the lever shifts to the slow feed and upon completion of the boring operation the lever again shifts automatically to reverse position, giving a rapid return to the rail units. When this cycle has been completed, the feed is thrown out until it is again engaged by the operator. The rate of feed can be changed by simply adjusting a valve in the Oilgear pump. In addition, the oil circuit can be arranged to give two slow feeds forward, if desired.

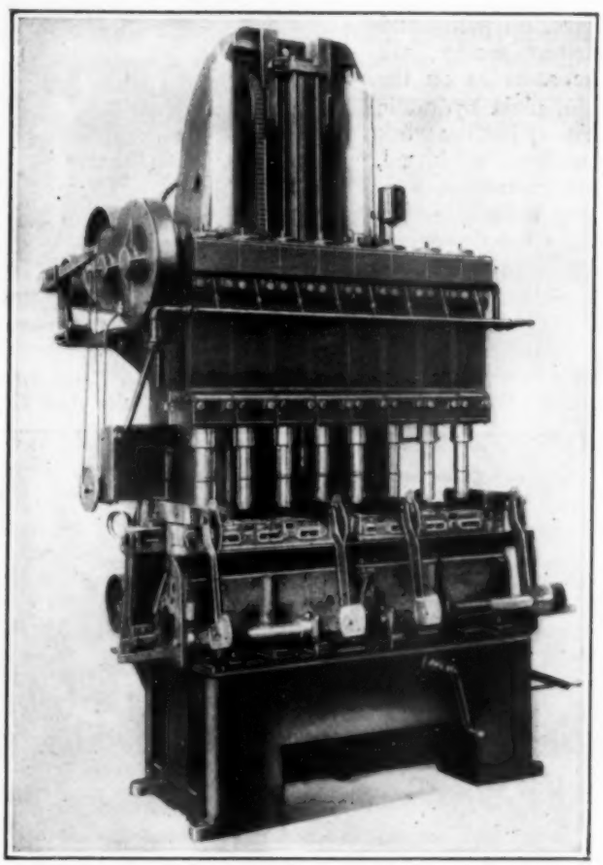


Fig. 1—Moline No. 13 Hydraulic Feed Cylinder Borer

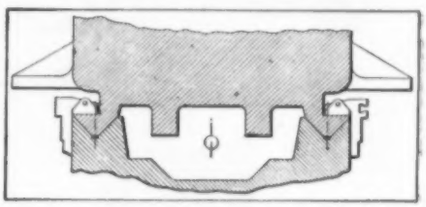


Fig. 2—Cross-sectional view of the slide and column double V-guide construction

In the illustration, Fig. 1, the No. 13 machine is shown completely tooled up for an eight-cylinder motor. The fixture does not bolt direct to the V-guides but clears the face of the column and is bolted to the wings at the side of the column, so that a longer slide can be used. Adjacent spindles bore alternate holes in the block. This arrangement is necessary on account of the spacing of the cylinder bores being too close to permit the use of a straight-line spindle construction when roller bearings are employed. One cylinder is completed at each cycle of the machine. The castings are brought to the machine on a conveyor and are pulled into the fixture by means of the latch mounted on a rack operated by a crank at the front of the machine. Each time a new block is pulled into the fixture, the one completed is forced out at the right-hand side of the machine. In this manner, the blocks are brought to their approximate location and are permanently located by pins raised into holes in the pan rail by means of a lever on the right-hand side of the base. Then by movement of another lever, the weights are dropped and the two castings securely clamped. The clamping levers are adjustable

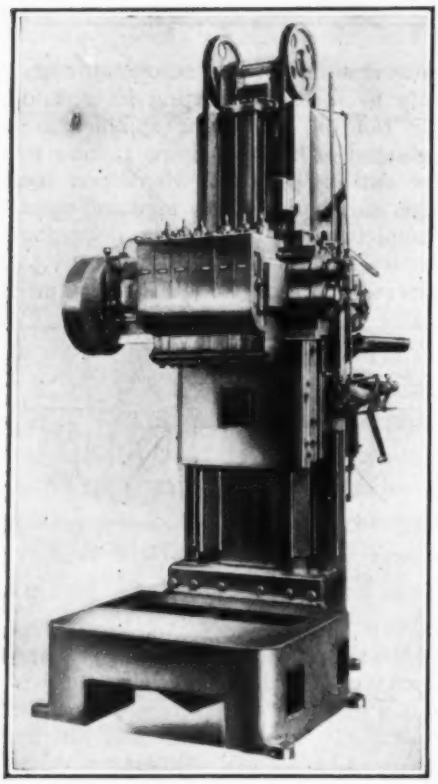


Fig. 3—Moline No. 10-D Cylinder Borer

through the eccentric plates shown at the top of the clamps.

The No. 10-D machine, Fig. 3, is similar to the No. 13, except that it is somewhat smaller and that spindle units having tapered bronze bearings are used in place of those having roller bearings. This construction permits closer center distances. This unit is recommended where the boring bars are piloted at the top and bottom of the fixture. The feed control and all Oilgear equipment is identical to that used on the No. 13 machine.

The approximate floor space required for each model is 7 ft. 8 in. by 6 ft. 4 in. and 7 ft. 2 in. by 5 ft. 4 in., while the approximate shipping weights are 22,925 lb. and 16,500 lb., respectively. The spindles in each case are made to suit, as is also the maximum distance from spindle to base of fixture.

Circle C High-Speed Steel

Announcement is made by the Firth - Sterling Steel Company, McKeesport, Pa., of an improved high-speed steel to be known as Circle C. Tests made by the company indicate that with this steel it is possible to cut manganese steel at speeds from 7½ to 15 ft. per min. with cuts ranging from $\frac{1}{16}$ to $\frac{5}{32}$ in., and feeds from 1/60 to 1/50 in. The chip formed from this material, heretofore considered unmachinable, is a very tightly-curled ribbon, oily smooth on the underside. Cuts as small as $\frac{1}{64}$ could be taken. The time of cut between grindings of the tool ran from 1 to 9 hours.

The treatment of Circle C steel does not differ radically in procedure from that for other high speed steels, but it does require a definite increase in the heats used. The steel is intended for the machining of billets, heat-treated forgings, phosphor bronze, and the boring and turning of tires and wheels of railroad equipment.

Landis Semi-Automatic, Hydraulic Valve Face Grinder

THE Landis Tool Company, Waynesboro, Pa., has placed on the market the semi-automatic, hydraulic valve face grinder shown in Fig. 1. It is a high-production machine developed for grinding similar parts in large quantities, but it may be converted from the grinding of one type or size to another by changing to a suitable work-holding fixture.

The bed of the machine, together with the grinding-wheel base, rear drive, oil pump and water service, are the same as on the 6-in. plain hydraulic grinder but the work carriage, workhead, and cross-slide have been designed especially for the grinding of valve faces. The live spindle workhead is mounted at an angle of 45 deg. on a cross-slide, which moves at right angles to the axis of the grinding wheel spindle.

The cross-slide is moved toward or away from the wheel by hydraulic power operating through a piston at the rear of the head. A ½-hp., constant-speed motor mounted on the head drives the work spindle through

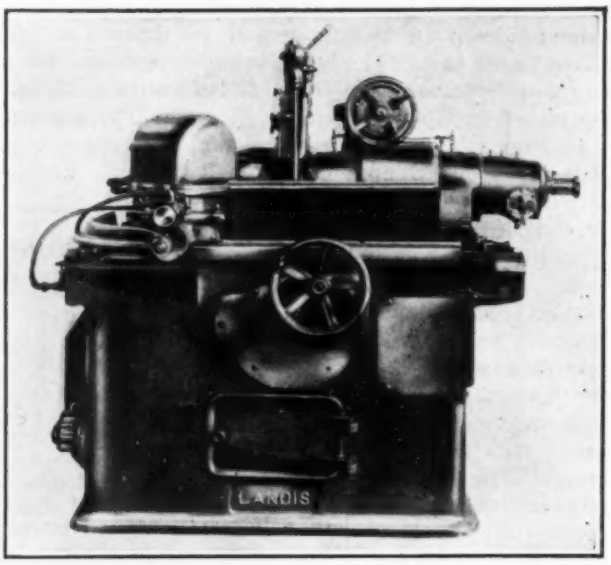


Fig. 1—Landis Semi-Automatic, Hydraulic Valve Face Grinder

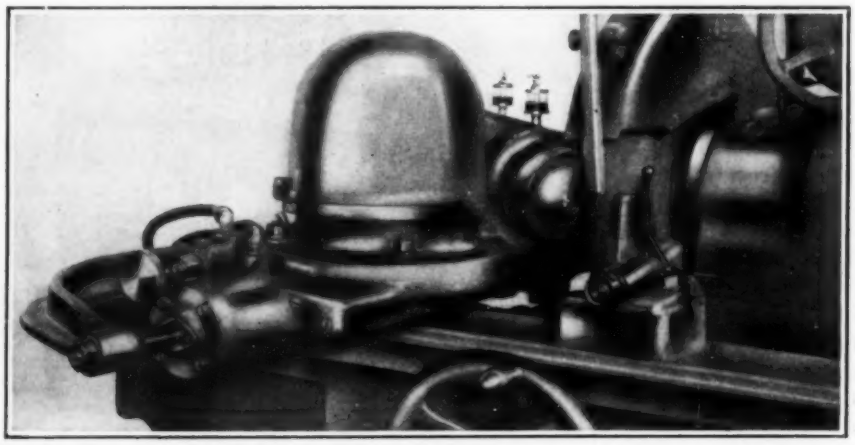


Fig. 2—Close-up view of the workhead, wheelhead and diamond holder

a silent chain and sprocket. Movement of the head regulates automatically the rotation of the spindle. A single lever at the front of the slide controls this movement through a reversing valve. The air-operated work holding fixture consists of a clamping block on which the valve stem is placed, a clamping arm carrying the clamping shoe, and a locator that positions the valve so that the face will be properly presented to the wheel.

When the workhead is in the back position, the clamping shoe is released and the rotation is stopped. In this position the valve is placed on the work holder. When the control lever is pushed away from the operator, the workhead moves toward the grinding wheel, the work is clamped, electrical contact is made, and the work starts to rotate. The workhead continues to move rapidly toward the grinding wheel until contact is made between the wheel and the work, when it automatically slows down to the proper grinding feed and continues to move in until it comes against a positive sizing stop. After grinding is completed, the control lever is reversed, causing the work head to return.

The grinding wheel head is equipped with special alloy-steel spindle running in bronze cap bearings, pressure lubricated. A 24x1x8-in. wheel is used. A reciprocating-type wheel spindle is furnished, so as to eliminate wheel marks from the work and cause the face of the wheel to wear more evenly. The equipment includes a standard 6-in. plain hydraulic wheel-truing fixture, which is clamped to a pad on the top of the special work carriage. Power for the workhead feed is furnished by a geared oil pump driven from the rear drive shaft, a portion of the base of the machine serving for oil storage.

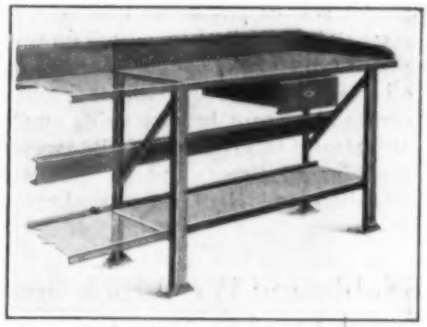
The machine may be arranged for either lineshaft or direct motor drive, although in either case an electrical work-drive motor is required. A 5-hp., 1,150-r.p.m. main-drive motor is used.

Pollard All-Steel Work Benches

A complete line of steel work benches has just been placed on the market by the Pollard Bros. Manufacturing Company, 4039 North Tripp Ave., Chicago, Ill. The illustration shows a complete work bench with a phantom outline indicating the continuous type.

These steel benches are made in several different lengths and widths. Standard lengths are 3, 4, 5, 6, 8, and 9 ft., and the widths are 24, 29, 32½, and 46 in. The height varies from 25 to 35 in., according to requirements, but the standard height of bench legs are 32½ and 35 in. The tops are made of ⅛-in. steel and are formed down and under both the front and the back so as to provide maximum strength.

The benches can be equipped with end plates and back plates to prevent material from sliding off the bench.



Pollard All-Steel Work Benches

The stringer that ties the legs together, however, is necessary for the construction of the benches. Standard drawers can also be furnished.

Improved Springfield Production Lathe

AN IMPROVED lathe, rearranged for production work, is being presented by The Springfield Machine Tool Company, Springfield, Ohio. The machine shown in the accompanying illustration retains the regular Springfield headstock design, with all ball bearings and all gears drop-forged, heat-treated, and running in oil. In place of the rapid change gear device, however, an instantaneous feed box is used, giving six changes of feed for each setting of the change gears. There is an automatic stop on the feed rod. In place of the lead screw, a power rapid traverse screw is employed, which is operated from the front. In the rear of the machine is mounted a taper attachment and oil pump.

The turret toolpost shown in the cut can be interchanged with a com-

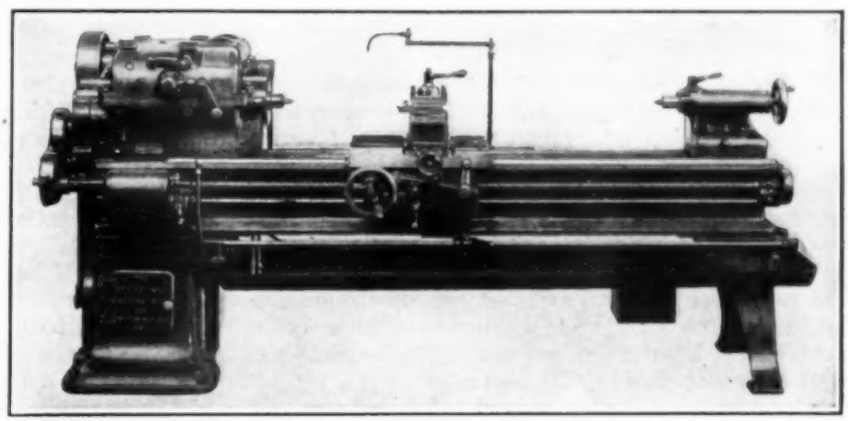


Fig. 1—Improved Springfield Production Lathe

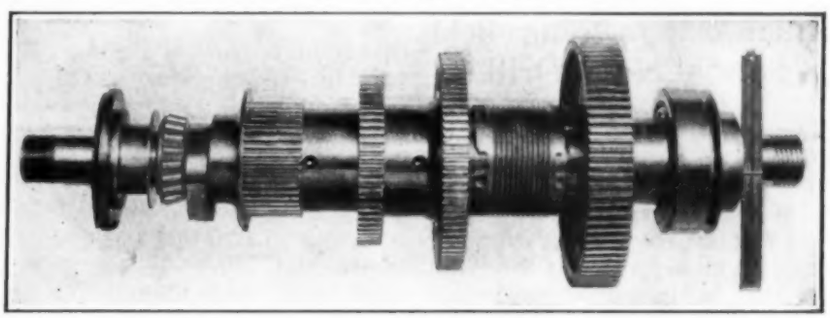
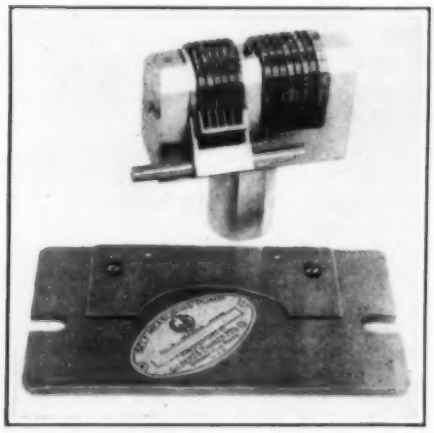


Fig. 2—Spindle mounted in precision-type Timken bearings

pound rest or any other type of tool rest. The spindle is mounted on precision type Timken roller bearings on all sizes of lathes. The thrust is taken up on the front bearing with ample adjustment to keep the spindle free of slack at all times, and to eliminate vibration and chatter on production work.

Noble and Westbrook Special Double Numbering Head

The numbering head illustrated was designed by the Noble & Westbrook Manufacturing Company, Hartford, Conn., to materially reduce the cost of numbering name plates as shown.



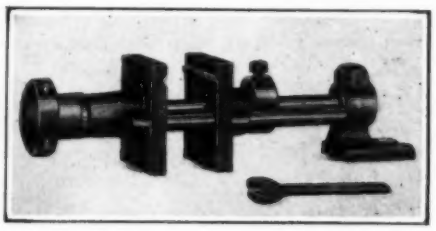
Noble and Westbrook Special Double Numbering Head

The six wheels at the left work automatically for serial numbers. In the center a star-design segment stamp is inserted directly into the support. The wheels at the right are changed by hand as required. These wheels mark such information as catalog number, model number, date, and any other information that is desired by the user.

Miller & Crowningshield Special No. 1 Drill Press Vise

One of the features of the special No. 1 drill press vise made by Miller & Crowningshield, Greenfield, Mass., is the fact that the jaws are machined square on all sides so that the entire vise can be turned any side up. Round, square, or hexagon rods can be held so that drilling can be done on the end or on the sides. By loosening the clamp screw in the collar, the operator can slide the rear jaw to any position and rigidly clamp it. The work is held by tightening a clamp knob at the front of the jaw.

The guide bars form a convenient place on which to rest work while drilling. The small shoulder on one jaw also provides a stop or rest for locating small pieces. The angular casting at the rear can be bolted to the drill press table to prevent the vise from swinging around, should the drill catch in the work.



Miller & Crowningshield Special No. 1 Drill Press Vise

The jaws have a width and height of 3½ in., and have a maximum opening of 6 in. The weight of the vise is 10 lb. complete.

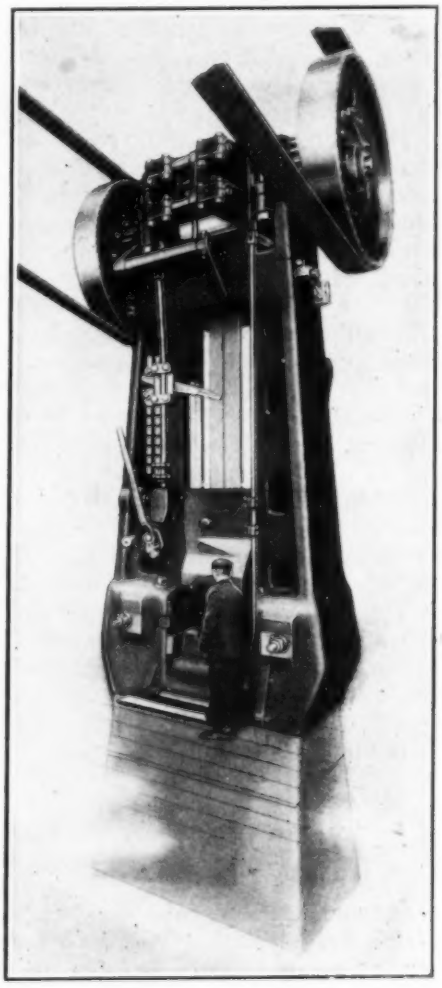
Billings & Spencer Model E Board Hammer

THE large size board drop hammer illustrated has recently been placed on the market by the Billings & Spencer Company, Hartford, Conn. It is claimed that the test of it for more than six years in the company's own special forge shop dispels old notions that large-size board hammers do not retain the economical advantages of the small-size board hammers. The Model E hammer shown is made in sizes from 4,000 to 7,500 pounds.

The difficulty of lifting the heavy ram on a board has been overcome by the use of two sets of rolls, one above the other, and equalizing their lifting action by a system of levers. Thus, excessive pressure on the board is eliminated, and no increase in width of the board is necessary. The action of the hammer is automatic, so that as long as the operator holds his foot on the treadle, the ram continues to strike at the rate of 55 to 60 blows per min. This results in maximum output, and as every blow is of equal force, uniform output in size and internal structure is maintained.

Fullering, or edging, can also be done on the Model E hammer without danger of destructive stresses. The twist in striking a blow on the edge of the die is taken up on the guides, the board being free to play crosswise between the rolls.

The hammer is of extra-heavy construction, the weight of the base being in the ratio of 20 to 1 to the weight of the ram. Forgings can thus be made with fewer blows. The uprights are steel castings, in order to give strength and rigidity without excessive weight. A knock-off provides for an adjustment to allow the hammer to work equally well on thick or thin dies. Friction adjustment on the rolls can be made from the floor.



Billings & Spencer Model E Board Hammer

Thomson No. 41 Butt Welder

A BUTT welder, designed primarily for welding sheet metal automobile body assemblies, has been placed on the market by the Thomson Electric Welding Company, Lynn, Mass. The machine is large enough to handle seams up to 50 in. in width, and was designed for handling automoble stock sheets 0.53 in. thick. It is claimed that this method of butt welding sheet metal for visible automobile body surfaces that require a high finish can be used extensively because of the small amount of finishing needed after the weld is completed.

The frame of the machine is of cast iron of light construction, as only light pressures are required. The clamps on the right platen are made in two separate units, and their brackets form two sub-platens mounted so as to permit $\frac{1}{8}$-in. adjustment up and down, sideways or backward and forward, in order to obtain the necessary alignment of the welding dies. The clamping jaws and levers are brought into position by hand, and then the final clamping pressure is applied through air cylinders, the control valves of which are mounted at the front of the welder. When the air pressure is released, the clamps are unlocked by hand and counterweights then cause them to open.

The push-up mechanism and drive mechanism consist of a 3-hp. motor connected to a reduction gear unit and through spur gearing to the camshaft. The cam on the welder is built to give a $\frac{5}{8}$-in. platen travel, but greater travel of the platen can be obtained, if desired. The gross weight of the machine is 20,000 lb., and is occupies a floor space 92 in. long by 48 in. wide.

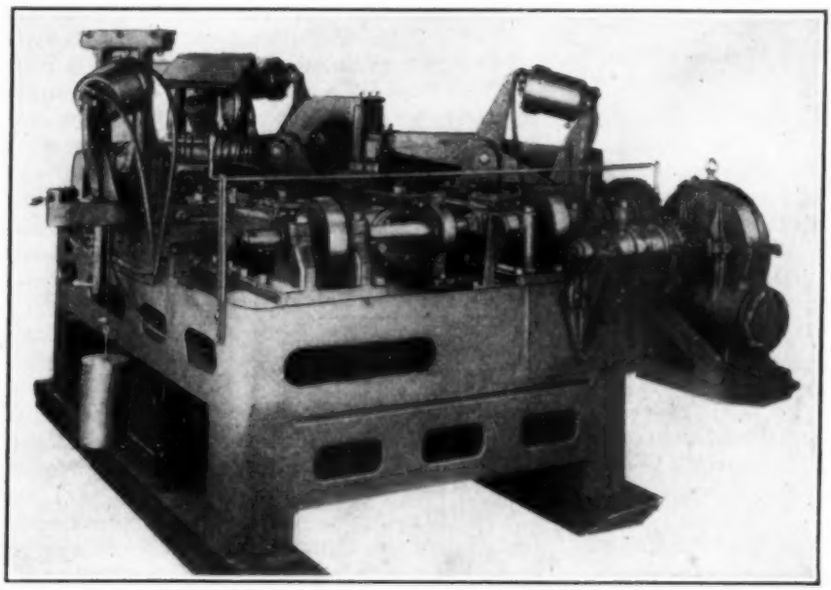


Fig. 1—Thomson No. 41 Butt Welder

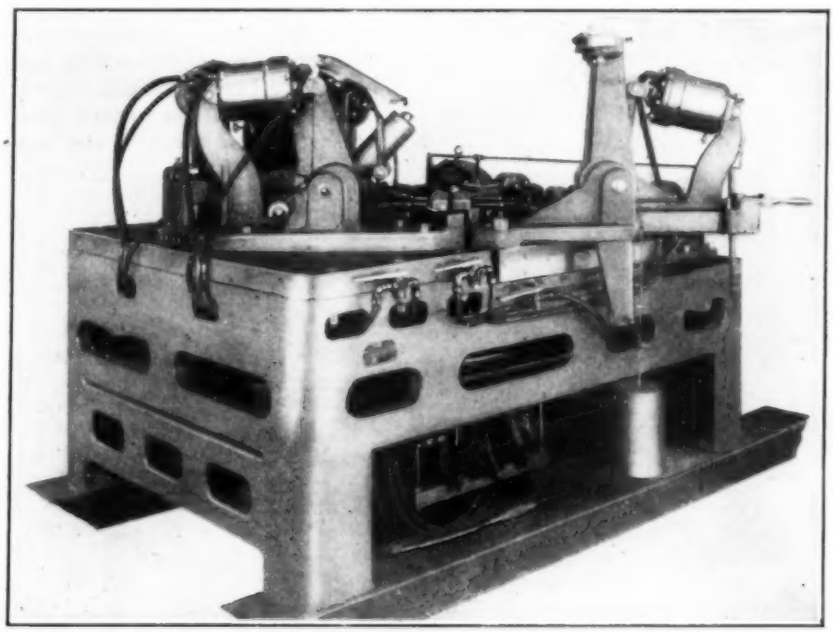
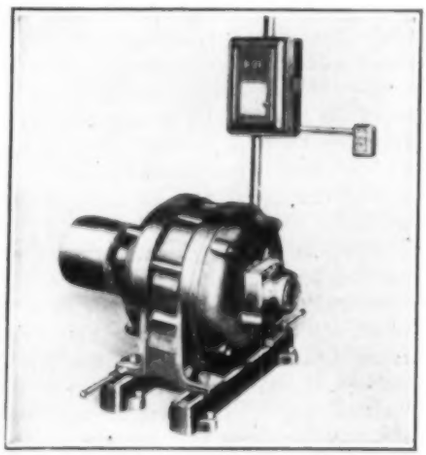


Fig. 2—Another view of the Thomson No. 41 Butt Welder

Allis-Chalmers Line-Start Induction Motors

A line of squirrel-cage induction motors suitable for starting on full-line voltage is being placed on the market by the Allis-Chalmers Manufacturing Company, Milwaukee, Wis.



Allis-Chalmers Line-Start Induction Motors

These motors are normal-torque, high-reactance machines, and will not draw starting current in excess of the limits recommended by the Electrical Apparatus Committee of the National Electric Light Association.

The motors are built in ratings of $7\frac{1}{2}$ to 30 hp., 600 to 3,600 r.p.m., low voltage, and are available for either

sleeve or roller bearings. All the constructional features used in the standard squirrel-cage motors made by Allis-Chalmers are retained in this line. A magnetic switch with push-button control is the only starting equipment required.

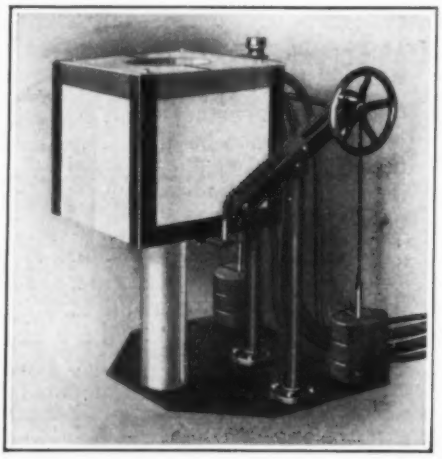
Ajax-Northrup High-Frequency, Drop-Coil Furnace

The Ajax - Northrup high-frequency, drop-coil furnace illustrated was developed by the Ajax Electrothermic Corporation, Division of Ajax Metal Company, Trenton, N. J., in an effort to meet the following characteristics of an ideal melting furnace: The shape of the metal bath to approach that of a cylinder whose height is equal to its diameter because this shape has small radiating surface per unit volume; little or no waste space to be above the melt; aperture for charging to be large and easily accessible; heat to be generated uniformly throughout the mass to be melted; thorough mixing of alloys without the use of stirring rod or any motion of the furnace; crucible of standard shape to be removable for pouring; minimum refractory material to be heated; and high efficiency.

It was found that the use of the high-frequency current met these conditions for ferrous, non-ferrous and semi-precious metal melting. The metal is melted in a crucible surrounded by heat insulating material, and the heat is generated by induction within the metal and in the crucible wall.

There is no physical electrical connection between the crucible and the electrical circuit. The energy is supplied by electric-magnetic induction from a coil surrounding the crucible but separated from it by about an inch of space. Between the coil and the crucible there is a heat-insulating lining through which the electrical energy passes. The lining has small mass in which little heat is stored. The coil itself consumes little power and is kept cool by a water circulating system. The furnace is housed in a box of non-conducting material such as asbestos board.

Beside metal, non-conducting materials can be heated in this furnace in a conducting crucible. For example, Pyrex glass can be melted in a graphite crucible. The furnace can be used with either graphite or non-conducting crucibles for melting zinc, lead and other low temperature, high-resistivity metals and alloys.



Ajax-Northrup High-Frequency, Drop-Coil Furnace in melting position

When a metal is to be poured into sand molds, the crucible can be lifted from its pedestal in the furnace by means of tongs and carried to the mold and poured. In this case the outside housing surrounding the crucible is lowered, thus exposing the crucible on its pedestal for handling.

The Ajax-Northrup drop-coil furnace is made in two standard sizes; the larger size operates from a 35-kva. converter and holds a No. 25 crucible. It melts about 65 lb. of brass in less than an hour from a cold start. The smaller size furnace is for use in melting precious metals.

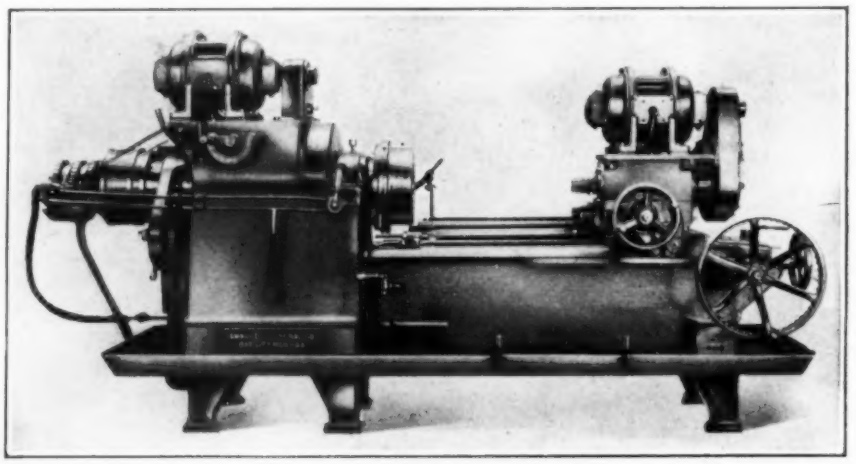
A feature of these high-frequency induction furnaces is the automatic mixing of alloys. As soon as the metal starts to melt, a pool is formed in the bottom of the crucible and violent stirring action occurs in the metal due to the attraction of currents set up in the outside of the bath.

The furnace is counterweighted and is supplied with a handle by means of which it can be raised and lowered without the use of power.

Smalley No. 20 Thread Miller

AS IN the case of the No. 23 thread miller made by the Smalley General Company, Bay City, Mich., the object of the design of the No. 20 machine has been to build a rigid machine capable of doing heavy work without chatter. The unit is a production machine, but consideration has been given to make it possible to change it quickly from one job to another so that it approaches a jobbing machine. It is feasible to operate it profitably on small quantity runs. On this machine it is possible to mill outside or inside, right- or left-hand threads, and when equipped with a taper attachment, to mill straight or tapered threads up to a taper of 4 in. per foot.

The outstanding improvement in this machine is the roller bearing milling head. The milling spindle and the pinion shaft that drives it are mounted in Timken tapered roller bearings. The milling spindle is equipped with a No. 13 Brown & Sharpe taper and is driven by helical gears running in oil. The milling head is so arranged that it is easy to attach a turning tool so that surfaces adjacent to the thread



Smalley No. 20 Thread Miller

can be turned true with it. The entire head is rigidly constructed so that chatter is eliminated and the life of the hob increased materially. Experience has shown that because of this rigidity also, it is never necessary to size die or tap a piece of work after the milling is completed.

The machine will mill external threads from $\frac{1}{4}$ to 8 in. in diameter and internal threads from $\frac{1}{2}$ to 12 in. in diameter. The available pitches run from 30 per in. up. The machine can also be used advantageously for form milling in many cases.

The main spindle has a hole $6\frac{5}{8}$ in. in diameter through the center and is flanged at the front end, making quick changes of chucks possible. Several types of chuck may be used, depending upon the work to be done, and upon the quantity of pieces to be milled. The chuck shown is a 5-in. three-jaw chuck operated by a hollow air cylinder. This permits long work, 5 in. in diameter to be put through the spindle. The main spindle is mounted in bearings cast integral with the bed, thus preserving a permanent alignment. The bed is heavy and rigid. Two kinds of speeds are provided for the main spindle, one for turning and one for milling.

Either Motor or Belt Drive Provided

This machine is said to be heavy, but easily operated. It is built in either motor or belt drives. The motor-driven machine has eight speeds on the main spindle, and six on the milling spindle, when a four-speed motor is used. The belt-driven machine has a three-step cone on the main spindle, and a pulley on the pinion shaft of the milling head. Separate countershafts are provided for each spindle, and each has two friction pulleys so as to obtain two speeds or reverse speeds on the countershaft.

Although the machine is primarily of the chucking type, it can be furnished with a tailstock and live center and work swung on centers. When a long overhung arbor is required, an overarm can be used to support its outer end, thus making the arbor more rigid and in turn reducing chatter.

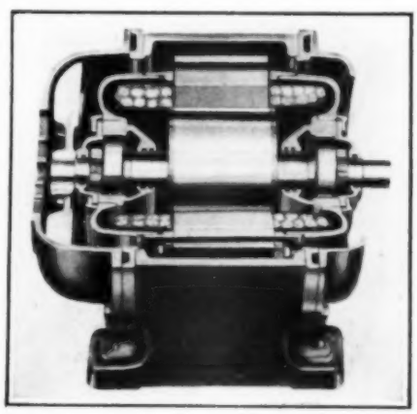
In making taps and dies, it is often desired to relieve them. This can be done with a relieving attachment, which can be furnished so that the taps can be milled and relieved at the same time after fluting.

The patented feed mechanism is so designed that the wear is distributed over the whole length of the thread on the lead screw instead of coming at one place, as in a lathe. This design results in greater accuracy and longer life. It is not necessary to wait for a split nut to pick up the thread as in a lathe; the feed lever can be thrown in at any time. By this device, a thread can be started at any point on the circumference of the work. For instance, double and triple threads have been milled with a single ring tooth cutter and all threads were in proper lead and pitch with each other.

A reversible coolant pump is installed to provide an ample supply of cutting fluid to the hob. It is so piped that the fluid can be directed either from the inside or the outside of the work.

American Electric Motor Company Totally-Inclosed Motors

An improved type of completely inclosed ventilated motor with a 40-deg. rating, was recently announced by the American Electric Motor Company, Cedarburg, Wis. This company recently became a subsidiary of the Splitdorf-Bethlehem Electrical Company. Under severe test it has been found that dust, sand, iron filings and sawdust cannot get into the winding as they are hermetically sealed in hoods. The hoods are telescoped into a ring fastened to the stator laminations, the surfaces of which are machined. Cooling is accomplished by driving air through, as well as over the stator laminations. The stator core is perforated, thereby making it possible to remove the heat at the point where it originated. Air in the enclosed portion is agitated by malleable cast fans shrunk on the motor shaft.



American Electric Motor Company Totally-Inclosed Motor

Ball bearings contained in dust-proof housings support the rotor shaft. Felt washers keep out the dust and grit and retain lubricant in the bearings. The enclosing hood of the motor can be removed without disturbing the bearings, which remain on the shaft enclosed in separate cartridge-type housings.

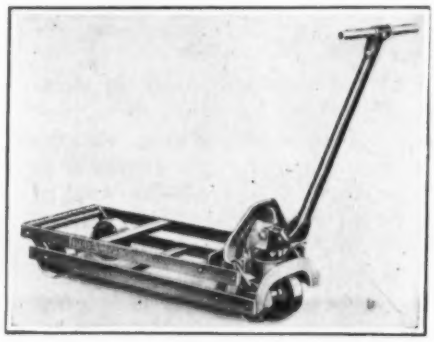
The stator is removable and can readily be replaced in case of damage. The stator windings are built to withstand severe conditions. The top of the slot is sealed by a U-shaped wedge. The ends of the windings are taped well within the slot to eliminate any possible chance of breakdown between the wire and the end of the slot insulator. The stator windings are treated with a special oil- and acid-proof varnish, carefully dried so as to retain its flexibility. The rotor is of the usual construction with the exception of its windings. The end rings are electrically welded to the bars and form a one-piece squirrel cage of uniform material.

Lewis-Shepard Type R Single-Lift Elevating Trucks

Two series of single-stroke lift trucks with an effective lifting range of 180 deg., and with great mechanical advantage, are being made by the Lewis-Shepard Company, Watertown Station, Boston, Mass. One of the important features is that the lifting mechanism is so constructed that the handle is never disengaged from the load. The amount of lift is $1\frac{3}{4}$ inches.

The lift is accomplished by two actions, a rolling movement and a direct vertical thrust movement. The rolling movement minimizes friction and the thrust movement applies its force directly to the movable platform. With this type R truck with the handle to the side, the lifting means can cause no tendency to tip the load, because the pulling force is always centered. The rolling and thrust movement makes this possible.

The type R single lift trucks are made of malleable iron and steel. The wheels only are made of cast iron. Full sized roller bearings are used in all wheels, which are carried on hardened steel axles. The locking



Lewis-Shepard Type R Single-Lift Elevating Truck

frame is in the center so that undue strain is not placed on the truck when it is carrying the load. The frame is of welded construction.

Two series of trucks are available. In type R, the minimum platform width is 22 in. and the maximum 36 in., while in the type WR, the minimum platform width is 28 in. and the maximum 46 in. The lowered height varies from 6 to 9 in. The capacity of all models is 2,500 lb., the only variables being the dimension of the platform, the lowered height, and the wheel diameter.

Fusion Welding Electrodes

Announcement is made by the Fusion Welding Corporation, 103d St. and Torrence Ave., Chicago, Ill., of the development of two mild steel welding electrodes, which are being marketed under the names of "Blue Streak" and "Yellow Jacket," respectively. The Blue Streak is a fast-flowing electrode, melting more rapidly than the fast-flowing bare wire, and at the same time having more arc stability than flux-coated rod. It is stated to be especially suited to the welding of medium- and light-gage plates and sheets. It is a full flux-coated electrode.

The Yellow Jacket electrode is surfaced, and is designed to give great penetration when used with high current on heavy material. Half-inch mild steel plates have been welded at a rate of more than 20 ft. per hr., without beveling the edges.

Lincoln Automatic Induction Starter

An automatic induction starter with two adjustable features, is announced by the Lincoln Electric Company, Cleveland, Ohio. This starter is shown in the accompanying illustration. One of the adjustments is in the starting current and starting torque, and is made by changing the position of the rotor in the regulator. This rotor is index mounted, and the starting torque and current are increased by going to the higher numbers of the scale and are decreased by going to the lower.

The other adjustment is in the current at which the throw-over takes place. The throw-over is controlled by a retarding solenoid which is operated by the motor current. The pull of this solenoid can be adjusted by a simple lock rod arrangement

For mounting purposes, the switch may be considered as consisting of three parts, the back cover, the front cover, and the switch itself. In mounting, the back cover is first secured to the wall. As the back cover contains conduit outlets, the wires may be drawn in easily before the interior mechanism is set in place.

With this automatic induction starter, the motor is controlled by the conventional start and stop buttons. When the start button is depressed, it applies the correct voltage to the motor and the starting current is held within the desired limits. After the motor comes to speed, the current attained falls off. When it has fallen off to the desired amount, the switch automatically sets itself in the running position without interrupting the torque of the motor. The motor is removed from the line by pushing the stop button.

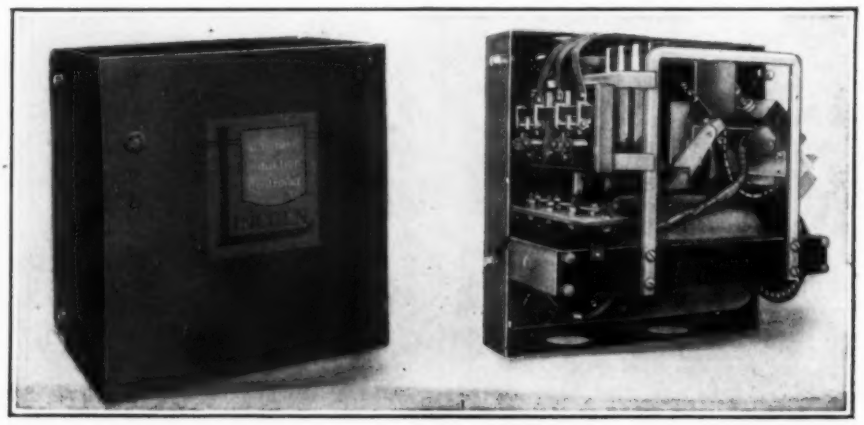
If the front cover is removed, the switch may be swung forward by the removal of the holding screw at the back. The barriers may also be moved upward out of the way. By the release of a screw on the control switch panel, the contact carrying arm will drop back, exposing all contacts for renewals or observation. The barriers completely inclose the contacts, and six separate arc chimneys are provided to confine the arcs. It is claimed to interrupt currents of ten times the rating of the switch without injury. The contacts in the switch are designed to give wiping action. Overload protection is afforded by thermo-relays, and the no-voltage protection by a no-voltage release control.

Cutter and Reamer Holder for Thompson Universal Grinding Machine

An improved cutter and reamer holder with tailstock has been developen by the Thompson Grinder Company, Springfield, Ohio, and is now included with all universal equipment on its standard 12x36-in. universal grinding machine.

With the holder in the position indicated in Fig. 1, the unit has a capacity for milling cutters up to 12 in. in diameter, straight or spiral teeth. It can be swivelled through a vertical plane, and also through a horizontal plane as shown, and is used with a cup wheel so that straight angle clearance can be obtained on the cutter teeth.

When reamers are to be ground on centers, as in Fig. 2, a special tail-



Lincoln Automatic Induction Starter

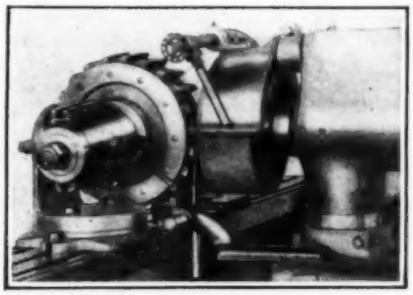


Fig. 1—Milling Cutter Holder for use on the Thompson 12x36-Inch Universal Grinding Machine

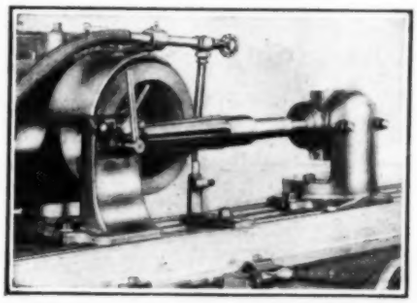


Fig. 2—Reamer Holder for the Thompson Universal Grinder

stock is used. It has a capacity for reamers 1½ up to 12 in. in diameter, and 36 in length. The tailstock is so designed as to permit the free passage of the cup wheel without interference on even the smallest reamers. A quick-acting movement is provided to the center, and a quick-action clamp for locking it in position.

The headstock is fitted with the new standard taper hole recently adopted for milling machines, and can be bushed down to any sized taper or straight hole with collets to fit the various shanks on reamers or arbors.

Trade Catalogs

CLUTCHES. The L. G. S. Manufacturing Co., Indianapolis, Ind., has prepared an illustrated catalog on its spring clutch. The principle of design and operation is first explained with the aid of cross-sectional views and then some typical applications are presented.

CRANES. The Whiting Corporation, Harvey, Ill., has prepared a booklet of instruction on the operation and maintenance of its electric cranes. The publication is known as Bulletin No. 179 and supersedes Bulletin No. 159. All the principal parts are illustrated and numbered for easy reference in ordering new parts. Each important unit is taken up in turn, such as gearing, bearings, wheels, motors and controllers. The pamphlet contains 32 6x9-in. pages.

DIE-CASTING MACHINE. The Madison-Kipp Corporaion, Madison, Wis., has prepared an illustrated leaflet describing its new die-casting machine and complete die-casting service recently described in these pages. The circular is illustrated.

DRILLS, GRINDERS AND BUFFERS. The United States Electrical Tool Co., Cincinnati, Ohio, has issued its catalog No. 24 on its products. This publication contains 56 8½x11-in. pages and is profusely illustrated throughout, largely with photographs. The line includes portable electric drills, stands and accessories, portable reamers, valve refacers, valve grinders, die grinders, electrical screwdrivers, portable grinders, bench and pedestal grinders, combination grinders and buffers, heavy-duty snagging grinders, and similar equipment.

LUBRICATION EQUIPMENT. The Dot Lubrication Division, Carr Fastener Co., 31 Ames St., Cambridge, Mass., has prepared a pamphlet on its product entitled "Better Lubrication for All Machinery." In it are shown typical applications of the Dot line of lubrication equipment, including guns and nipples of various types and sizes. The Dot-O-Matic pressure cups, tank equipment, and group lubrication system are also described and illustrated.

MILLING MACHINE. The Kearney & Trecker Corp., Milwaukee, Wis., has available for distribution Catalog No. 31, giving complete specifications of the 1400 and 2200 series Mil-Waukee-Mil recently announced in these pages. The outstanding features of the series are first enumerated, followed by specific details and ratings of each of the six sizes in each series. Both the Simplex and Duplex models are described and illustrated.

MONEL METAL. The International Nickel Co., Inc., 67 Wall St., New York, N. Y., has prepared a "Buyers' Guide of Monel Metal and Pure Nickel Products." The products are classified alphabetically, such as bearings, bolts, buckets, etc., and under each product head, the manufacturers are listed alphabetically. The publication contains twenty 8½x11-in. pages.

MOTORS. The Reliance Electric & Engineering Co., Ivanhoe Road, Cleveland, Ohio, has prepared Bulletin No. 202 on its Type T heavy-duty d.c. motors, supplied with either ball or roller bearings. Considerable space is devoted to outlining the advantages of anti-friction bearings and their proper mounting in the motor. The principal parts of the motor are illustrated, and several typical applications are shown. Complete specifications are also given.

PULLEY GRINDERS. The Graham Manufacturing Co., Providence, R. I., has prepared Circular L on its pulley grinders. The construction of the unit is explained with the aid of cross-sectional views and operating instructions are given. Two sizes of grinders are made and complete specifications for each are included.

ROLLER BEARINGS. The Rollway Bearing Co., Inc., Syracuse, N. Y., has prepared Catalog No. 4-A on its cylindrical roller bearings of the wide series and "Utility" types. The construction of the bearing is first described and illustrated, and tables of load ratings and dimensions are given. Some typical applications are also shown. The catalog contains sixteen 8½x11-in. pages, and is attractively prepared. The company has also prepared several other publications on its products. Bulletin No. 53 treats of the self-aligning, roller-bearing pillow blocks; Bulletin No. 54, precision types of Rollway radial bearings; Bulletin No. 55, roller bearing pillow blocks with standard bearings; and Bulletin No. 56, large Rollway bearings in International Standard sizes. Each bulletin is in the form of a page leaflet, printed on both sides, and is illustrated with both photographs and line cuts. Dimensional data and ratings are given in most cases.

SCREW CONVEYORS. H. W. Caldwell & Son Co., Western Ave., 17th and 18th Sts., Chicago, Ill., has issued Book No. 989 on its helicoid and sectional-flight screw conveyors. The catalog contains 85 pages, and is well illustrated throughout with both photographs and line cuts. It contains descriptions of the various types and parts, and gives dimensional data and prices in each case.

"Thermoplax." The Cutler-Hammer Manufacturing Co., Milwaukee, Wis., in a booklet attractively displayed and entitled "Come Adventuring," gives complete information on cold-molded Thermoplax. Many photographic examples are given where small metal inserts, trade marks, depressions and projections have been incorporated in parts of various shapes and sizes at the time of molding this insulating compound. Methods of using Thermoplax for such parts as handles and knobs for kitchenware, bases for switches, radio dials, motor terminal blocks, etc., are also described. Photographs of the factory where Thermoplax parts are made are also given.

WELDING EQUIPMENT, SPOT. The Thomson Electric Welding Co., Lynn, Mass., has assembled under a single cover all of its descriptive circulars on spot welding equipment. Some of the circulars are in the form of mimeographed sheets and photographs. Others

are printed forms. Besides general-purpose equipment, a large number of special machines are described and illustrated. Complete specifications are generally given. The descriptions are blocked off in titled paragraphs for convenience in determining the chief features of each design.

Pamphlets Received

DETERIORATION OF STEELS IN THE SYNTHESIS OF AMMONIA is the title of Technologic Paper No. 361 of the Bureau of Standards. The investigation was made to determine the best form of steel to use in the construction of apparatus used in the nitrogen fixation process. The test indicates that the carbon content should be low and that the addition of tungsten and chromium is helpful. An explanation of the mechanism of the deterioration of steels under these conditions is given. The pamphlet contains 36 pages, and is well illustrated with photographs and charts. Copies may be obtained from the Government Printing Office, Washington, D. C., for 15 cents.

FORGED TOOLS. The first revision of simplified practice recommendation No. 17 is now available. This particular revision has to do with eyes, and the number of sizes has been reduced from 120 to 10. The sizes are applicable to all kinds of forged, railway, farming and blacksmith tools. Copies of the recommendation, which is issued by the Bureau of Standards, may be obtained from the Government Printing Office, Washington, D. C., for 5 cents.

PERMANENT-MAGNET STEELS. The Bureau of Standards has issued Scientific Paper No. 567 entitled "Some Principles Governing the Choice and Utilization of Permanent-Magnet Steels," by Raymond L. Sanford, Physicist. The subject is introduced by a discussion of the demagnetization curve, together with the hyperbolic law and the ratio curve. A comparison of magnet steels is then presented, followed by a discussion of stabilization by partial demagnetization. A summary of conclusions is given. The paper may be obtained from the Government Printing Office, Washington, D. C., for 5 cents.

To Publish Handbook on Arbitration

The publication is announced by the American Arbitration Association of a new international handbook on commercial arbitration by the International Chamber of Commerce, which has been made possible through the co-operation of the International General Electric Co. and the American Arbitration Association in honor of the late Anson W. Burchard, first president of the association and chairman of the board of the International General Electric Co.

The commercial arbitration procedure for each country will be described in separate pamphlet form, in order to be readily available to business men engaged in foreign trade with such countries. The first instalment of the handbook describing "Commercial Arbitration under Swiss Law" has just been received by the American Arbitration Association. When the brochures for all countries are issued they will be combined and published in bound volume form as a complete manual on the commercial arbitration laws of the world. The completed volume as well as the separate pamphlets are being published in three languages, English, French and German.

Tendency Is to Build Efficiency of Workmen

A growing tendency in American industry toward policies of building up an efficient working force through special inducements and awards to wage earners, rather than by penalizing or "docking" workmen for deficiencies in their work or conduct, is noted by the National Industrial Conference Board in a study just completed dealing with "Supplemental Bonuses."

While bonus plans of various kinds have been experimented with in industry for many years, the earlier types of special incentives as a rule were in effect either profit-sharing plans or bonuses based merely on quantity of output. Supplemental bonuses, however, are incentives in form of an award in cash, or the equivalent, for the attainment of specific standards of accomplishment other than quantity of output. They are separate from and an addition to the stipulated wage, and are given generally for regularity and punctuality of attendance, long service, excellence of quality of output, for the prevention of waste, accidents and similar purposes.

A considerable number of large concerns have experimented with supplemental bonus plans with varying success, the board finds. A few plants have discontinued the policy, while others apply such bonuses only occasionally when it is felt that some special stimulus is needed to raise the general efficiency of the working force. Supplemental bonus plans, the board finds, had their inception during war years when labor was scarce and hence responded less to disciplinary control.

The application of supplementary bonus plans is not restricted to wage earners alone, but has been extended successfully by a number of large companies to supervisory employees and to executives.

The study offers no conclusions as to the general advisability of adopting supplemental bonus plans, excepting such as may be drawn by the reader from the experiences of various companies recorded in the report. The evidence of most of them is favorable, but some declare that no outstanding advantages have been gained through the bonus plans. The board's study is based on reports of 159 companies employing a total of more than 611,000 workers, 18 of which have abandoned their bonus plan policies.

Five Hundred Agencies in Research Work

That the efficiency of modern American business is not inherent but rather the result of intensive and scientific study of the many problems involved is indicated in a compilation of agencies engaged in market research just released by the Department of Commerce. More than 500 separate agencies, this publication reveals, are engaged in some form of market study. Government bureaus, chambers of commerce, co-operative marketing associations, newspapers and magazines, universities, advertising, and other business enterprises are among the agencies shown to have made investigations into marketing problems.

The products which have been subjected to this scientific scrutiny cover a remarkably varied field, ranging from corn to honey, and from fountain pens to automobiles. Studies have been made in connection with the marketing of carp, traffic in caged birds, methods of paying laundry drivers and operating expenses of undertakers. Such functions of business as accounting and budgeting, advertising, costs of doing business, credits and collections, installment selling, inventory methods and store management have been treated in their relation to various types of business.

With so many different agencies working along the same general lines, it is pointed out in the foreword of the publication, the possibilities of duplicating work already accomplished have always been present. It was to aid in eliminating this waste effort in American business that the Domestic Commerce Division undertook to gather all available data in connection with market research, including the publications which have been issued along these lines. According to Dr. Frank M. Surface, under whose direction this work was completed, it is now possible for any organization which contemplates conducting market studies to ascertain just what has been accomplished in any particular field.

NEWS OF THE WEEK

Hoover Awarded Saunders Medal and Lauds Our Engineers

Says American engineers have been envy of world

"OUR American engineering practice in many branches, particularly in mines, transportation, and electricity, has become the ideal of the world, and hundreds of demands have come from abroad for American engineers to install American machinery and American methods in other countries," said Secretary of Commerce Herbert Hoover, at the dinner of the American Institute of Mining and Metallurgical Engineers, held during the convention of the Institute in New York, Feb. 20 to 23. Mr. Hoover received the William Lawrence Saunders gold medal from the Institute in recognition of his engineering services.

The convention opened with a record attendance, and more than 1,100 were present at the dinner at which Mr. Hoover was the principal speaker. Announcement was made that the dinner was without political significance in view of the boom for Mr. Hoover's candidacy for the Presidency, but he nevertheless proved to be the chief magnet, and the speech was also broadcast through a nation wide "hook-up" of radio stations.

Mr. Hoover said in part: "Three great forces contributed to the development of the profession. The first was the era of intense development of minerals, metallurgy, and transportation in our great West. It greatly stimulated invention; it made a demand for training and skill on the part of our engineers. The pressure of national development advanced our American practice beyond the rest of the world.

"The leaders of our universities," continued Mr. Hoover, "were the first of all educators of the world to recognize that upon them rested the responsibility to provide fundamental training in the application of science to engineering under the broadening influence and cultivation of university life. They were the first to realize that engineering must be transformed into a profession. A third distinction that grew in American engineering was the transformation from solely a technical profession to a profession of administrators.

"Our American engineering practice became the envy and ideal of the world. American engineers were solicited to install American methods and American machinery abroad. Quickly their brillant success created a demand for more and more of their kind, followed by hundreds of others.

"Perhaps, few of us realize the effect of their service both at home and abroad. A vast sum of industrial advance over the whole world came from their hands. A vast amount of added experience was brought back to our country. A vast support was given to our manufacturers and workers in the export of American equipment. There grew up a vast appreciation of America as a land of intellectual as well as material accomplishment.

Exchange of Information

"The exchange of engineering experience and scientific discovery between nations is one form of internationalism that is beyond any reservation. America has made notable contributions to this advancement. Our metallurgy, our underground engineering, our many inventions for the saving of labor in every industry—our revolution in communications, and in scores of other directions—have been but part of our contribution to the common pool of human knowledge. And we have received more than we have given.

"One of the responsibilities of American engineering is to profit by every advance in every country, bringing its fruits to our own people. The job of the engineer is the application of science to the increased comfort and safety of man.

"Engineers have made magnificent contributions to progress. The gradually decreasing hours of labor, of greater stability of employment, of lessening sweat and drudgery from men, the widening comforts of life, the increased standards of living, the enlarged vision and opportunity to the individual, the stimulation to initiative and invention, are to no small degree the product of the engineering profession.

"And the engineers have come into a wider responsibility than solely the application of their technology—more and more the engineers themselves are the actual administrators of great industry. To them comes more and more the human problem of relations between employer and employee, the relations between producer and consumer.

"As our population grows in numbers, as our problems become more complex, so does also grow the need for wider and wider vision of the engineering profession. Our problems of transportation, of housing, of power, of communication, of economical use of our natural resources, of safety and protection to our people, now require long planning in advance. We no longer have a right to think in terms of our own generation. A greater America for our children will in large degree depend upon the engineering profession."

Harvard Offers Special Business Courses

In a six weeks special session for business executives given at the Graduate School of Business Administration, Harvard University, during the summer of 1928 courses will be offered in accounting policies, business policy and the Law; finance; marketing, sales management and advertising; marketing, retail store management and advertising; public utility management and economics, and railway transportation.

Each course will in itself require the full time of the men enrolled. The session extends from July 9 to Aug. 18.

Admission to the special session ordinarily will be limited to executives in responsible positions in business and to those actively engaged in teaching business administration or economic subjects. Other men actively engaged in business will be admitted providing their qualifications and business experience are approved.

General Electric Gets Large Motors Order

With the announcement that shipments of machinery and equipment with a total value of $2,500,000 now are in the process of transportation from Allentown, Pa., to the purchasers, the Pacific Coast Cement Co. of Seattle, Wash., it is learned that the General Electric Company will furnish the three main mill motors, each weighing 15 tons and of 750 horsepower.

The last of the shipments are due in Seattle by June 30. All of the main mill machinery, including two kilns 240 feet long and 11 feet 3 inches wide; two coolers 90 feet by 9 feet, and a crusher capable of receiving a rock 48 by 42 in. is being manufactured by the Taylor Engineering Manufacturing Co. of Allentown, Pa.

The Business Barometer

The outlook in Commerce, Finance, Agriculture and Industry

By THEODORE H. PRICE

Editor, Commerce and Finance, New York

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ALTHOUGH a thunderstorm generally clears the air, the clouds that announce its coming are apt to drive people indoors, and in the United States a decline in the stock market often has the same effect. The analogy was particularly close last week. Sentiment on the Stock Exchange has become less bullish. Many of the more active securities are lower. Some of those that are "unseasoned" have dropped sharply and while there has not been any demoralization it is becoming apparent that prices can go down as well as up.

The result has been a disappearance of paper profits and a lessening of the exuberant optimism that was generated by the continuous advance and served to obscure the reaction in trade that commenced in the autumn of 1927 and has continued until recently. Thus far the liquidation in the stock market has worked a decrease of only $90,000,000 in brokers' loans and as their reduction has come to be regarded as an essential of a sound credit position a further decline in security values would seem to be both probable and desirable. But business is improving meanwhile and it is quite possible that the high record of 1926 will be reattained by the time the Stock Exchange recovers its balance.

The continued advance in corn, for which some authorities are now predicting $1.20, and the strength of the other cereals have promoted the return of confidence in the Middle West. The merchants there are more cheerful than for some time and an active summer is now expected. In the South a better feeling has also been evoked by the recovery in the cotton market, and the governors' meeting at Jackson, Miss., where a 10 per cent reduction in the acreage was recommended. Of course no one expects that this recommendation will be accepted literally, but if the increase of 10 per cent that was predicted a month ago is prevented the result would probably be a further advance in cotton. This probability is reflected in the cotton goods market where the demand is improving and prices are somewhat higher.

Another encouraging feature is the promptitude with which the unemployed are being provided for. In New York the state and city authorities are starting work on many public improvements that would not have been begun until the late spring, and the example thus set is being followed elsewhere. The effect should be an increased demand for both labor and material, and with the coming of spring there ought to be jobs for all those who really want work.

The *Iron Age* says that steel production is holding its recent gains and is perhaps a shade higher than it was. Larger sales of motor cars are reported by some companies and farmers are said to be free buyers of agricultural implements and machines.

Car loadings for the week ending Feb. 11 are about 6 per cent under last year, but of the decrease amounting to 54,000 cars, more than 48,000 were coal cars. The coal industry, the oil industry, and the lumber trade are in fact the three darkest spots on the business chart of the United States, and it is hard to say what can be done to lighten them.

There is overproduction in each case and while there is reason to hope that the consumption of oil will soon catch up with the supply there is also reason to fear that oil has permanently displaced coal in many instances just as steel and concrete now are being used where lumber used to serve. Therefore those who can find new ways of utilizing coal and wood will be entitled to a place beside the benefactors of humanity who have shown how to make two blades of grass grow where one grew before.

Rubber and sugar are two other commodities of which there is an overproduction, but as American consumers are gainers rather than losers by the low prices at which they are selling, our domestic prosperity is but indirectly affected by the economic distress of Cuba and the losses of the rubber producers in the East Indies.

At 27.80 for March delivery, rubber is lower than it has been since August 1924 when it sold at 18 cents. The decline is of course due to the belief that the British control of exports will be abandoned and it may be that bargain prices will again be seen. Sugar is also in a very interesting position. The Export Commission of Cuba has sold the balance of the 600,000 tons allotted to countries outside the United States, and the supply left available for export is being rapidly brought within manageable dimensions. If those who own it should decide to hold, higher prices would be seen.

The foreign news is in the main reassuring. The stabilization of the French franc is practically assured, and the eagerness with which new security issues are being taken in London seems to indicate that the feeling in financial circles there is much improved.

This expectation assumes easy money and good crops sold at fair prices. From the latest statement of the Federal Reserve System the first of these assumptions appears to be abundantly justified, but the agricultural outturn is entirely on the knees of the gods, and the farmer faces hazards that the city man is incompetent to appraise. For this reason it is to be hoped that some sane measure of farm relief or crop insurance will be passed before Congress adjourns. If not the issue will certainly thrust itself to the front in the coming campaign for the presidency.

WHAT'S DOING IN INDUSTRY

INDUSTRIAL conditions throughout the country, considered from a broad viewpoint, are much more balanced than at any previous time this year. In New England the automotive, electrical and airplane industries are enjoying the majority of new business.

SATISFACTORY schedules of orders on file are reported from Indianapolis, Detroit and the Philadelphia districts, these being principally automotive parts, fence wire, gear and printing equipment. In the Chicago field, while a brisk spring trade in railroad accessories is anticipated, no change is noted in the sluggish machine tool situation from earlier February figures; a condition attributable in large part to the lessening production in the furniture industry.

ACTIVITY in the railroad shops of the South points to increased employment and heavier payrolls throughout the Cotton Belt districts. Business in machine tools, automotive equipment, steam shovels and road building machinery is said to be distinctly on the upward trend. Buffalo machine tool dealers estimate that February business will show a twenty per cent increase over the same month last year, but point out that the contractor's equipment field is at the bottom of the scale. The high lights of large orders of the week come from Bridgeport, automatic machinery; Providence, lathes and automatic machinery; South, heavy railroad equipment.

The Industrial Review

Weekly progress of the machinery and machine tool business

THE following reports, gathered from the various machinery and machine tool centers of the country, indicate the trend of business in these industries and what may be expected from the future:

NEW ENGLAND

The current week showed increased activity among buyers in the machinery and machine tool field in this section. The automotive, electrical and airplane industries were represented in the majority of the orders placed. A Bridgeport builder closed on a substantial order for automatic machinery to be used in the production of automotive equipment, and plant activities will be increased at once.

Industrial construction in the proposed stage at Stamford, Brockton, Bridgeport and Concord (N. H.), includes printing and publishing plants involving printing equipment. A Providence manufacturer sold two lathes, two milling machines and a number of automatics. A western Connecticut builder closed on several lathes including 14 in. and 20 in. machines.

Industrial conditions are more balanced. Particular improvement and expansion is noted in the wire manufacturing industry. Manufacturers of plumbing supplies, valves, etc., have given indications of improvement but maintain short schedules, notably in Springfield, Boston and Bridgeport. The hardware manufacturers are well occupied on full schedules.

INDIANAPOLIS

The Dwiggins Wire Fence Co. of Anderson, Ind., is one of three companies involved in a $3,000,000 merger that is reported to be forming with the Crawfordsville Wire and Nail Co. and the Adrian (Mich.) Fence Co. as the other participants.

Machinery to be used in the regular production of automobile transmissions rapidly is being installed in the new building recently completed by the Warner Gear Co. of Muncie, Ind. A satisfactory schedule of orders now is on file and will insure steady operations far into the summer.

The factory building and real estate of the Durant Motor Co. at Muncie, Ind., have been sold to the Merchants Trust and Savings Co. of that city. The factory has not been in operation for more than two years and the machinery was removed at the time the plant shut down.

The Connersville Blower Co. of Connersville, Ind., has filed papers with the secretary of state in Indianapolis changing the par value of its stock from 7,000 shares at $50 a share and $400,000 preferred, to 35,000 shares of no par value common and $400,000 preferred.

CANADA

Tariff changes announced recently by the Canadian Government affect the machinery industry to a certain extent. Machinery parts for blowers of iron or steel will enter the Dominion free. Formerly they paid a duty of 15 per cent British preference, 25 per cent intermediate and 27½ per cent general tariff. Machinery for the concentration of ores, metals or minerals will enter at 10 per cent British preference, 15 per cent intermediate and 20 per cent general. The former rate was 20 per cent, 27½ per cent and 30 per cent.

Mine hoists of a class not made in Canada are reduced from 15 per cent, 25 per cent and 27½ per cent to 10 per cent, 15 per cent and 20 per cent.

Complete parts of engines to be used in fishing boats receive the rate of 10 per cent British preference, 12½ per cent intermediate, and 15 per cent general.

As assistance to the textile industry, the duty on machinery incidental to the working up of fibrous material will be adjusted. On a small part of the machinery imported under the tariff known as item 467 there will be no change, but on a large part of the importation a reduction is proposed from 10 per cent to free under the British preferential tariff and from 10 per cent to 5 per cent under the intermediate tariff.

To aid aviation in the Dominion, the present low rate on aerial engines and parts will be extended two years; also a drawback of 50 per cent will be allowed on materials used in the manufacture of aero engines. After July 1, 1930, no drawback will be paid unless 40 per cent of cost is incurred in Canada.

CHICAGO

The machine tool situation for the last week has remained on about the same level as that reported for the first half of February. While a fair amount of business has been transacted, such sales as have been made have not been of an important character. Figuring continues active on the lists issued by the Santa Fe railroad, the only road up to the present this year to enter the market on a budget basis.

Inquiries are, if anything, increasing in volume, and promise to develop a goodly amount of actual business in the near future. In no especial line of machine tools can it be said that there is a demand beyond normal for the season. Manufacturers of grinding machines report a steady and satisfactory trade.

In wood working machinery reports are to the effect that business has somewhat fallen off, a condition attributable in large part to lessened production in the furniture industry. Used tools are in moderate demand, sales being largely limited to single items. Taken as a whole conditions in the machine tool industry, while susceptible to improvement, are generally favorable.

NEW YORK

Considering the short month, machine tool dealers in the New York market in general seem to be well satisfied with February sales. Those that have not done much business so far have enough quotations out to assure them of a fair business if only a fraction of them develop into orders. The fact that several production machines were sold on long delivery indicates that local manufacturers in the metal-working line are looking forward to increased activity in the spring.

Crane sales have been slow for some time, and the only item of note in the past week was the sale of a 5-ton crane to a concrete steel company in this city.

Some of the companies handling territories scattered throughout the country reflect in their activity the general trade activity indicated in other market letters on this page. Machines sold outside New York included a 36 in. "Timesaver" lathe, B. & S. screw machines, P. & W. die sinker, 12-in. vertical shaper, 20-in. lathe, two jig borers, and some second-hand equipment, such as two 10-ton cranes and a cotter drill. Two oil-electric locomotives also went to two steel mills.

Although little actual railroad buying has taken place this year, there is every indication that some business will be placed in the near future. One list of thirty machines has been pending for some time. Another road has asked for revised prices on an old list.

Among the equipment sold in this territory in the past week was four radial drills and two milling machines to the Wright Aeronautical Co.; two jig borers to an electrical company; a 6-in. vertical shaper to a similar company; a billet-sawing machine; a 20-in. lathe to the D. L. & W. R.R.; and a miscellaneous assortment of small equipment.

PHILADELPHIA

Business in the machinery and machine tool lines in Philadelphia is headed toward a satisfactory volume in the opinion of leaders of the industry in this market, who reported receipt of some orders and favorable inquiries during the last two weeks.

Manufacturers of gears reported the first three weeks of February were better than those of March, with some orders from the automotive industry, and some industrial lines in Detroit and Cleveland having been purchasers. Dealers who specialize in heavy equipment used by the railroads say prospects are that the carriers will enter the field for some extensive buying, although just now it is confined to replacements. The Lehigh Valley and the D. L. & W. were the principal carriers having ordered from this market. One of the Southern railroads has canceled its list until rate cases in which it is involved are settled.

Testing machine dealers reported a fair business early in February with inquiries that hold prospects for orders. Dealers in mill supplies reported some buying and producers of forging hammers reported sales to the U. S. Steel Corporation, with orders from steam shovel manufacturers, stone drill producers and gas and electric engine manufacturers.

BUFFALO

There has been a somewhat unexpected and gratifying upturn in sales and inquiries in the machine tool field of Buffalo. As this is written there is every indication that February, short month though it is, will be a much better business month in this field than was January or February, 1927. The number and nature of the inquiries also indicate that March will be a fine month. Some dealers say that February business, when the final figures are available, will show from ten to twenty per cent increase over the same month last year in some individual businesses.

In the electrical equipment field reports are not as favorable as those cited above but they still indicate that this February business will be as good or a trifle better than that of February, 1927. Small orders in quantity persist.

The contractors' equipment field is at the bottom of the shale at present. Practically no business is being done and no activity is expected until the middle of March at least.

DETROIT

While the machinery market in Detroit is still improving rapidly and more or less steadily and while the general atmosphere of Detroit and all of Michigan is decidedly optimistic there are still slight traces of spottiness noticed in the trade.

Most of the automobile companies are expanding and most of them are buying

equipment to take care of expansion. The body companies are all very busy and nearly all are making purchases, both large and small. All of the parts manufacturers and all of the industries associated with the production of automobiles are going along at a good rate and nearly all are in the market for some sort of equipment.

The Chevrolet car is selling at a rate that is at least as good and probably better than officials expected. The Dodge Victory Six is still selling rapidly and the Graham-Paige is apparently one of the hits of the industry. The Graham-Paige outfit is planning to turn out 350 cars a day, a decided step up in their capacity and equipment will be required to take care of this, it seems.

The Ford Motor Company is still going along slowly. No great increase in employment or production has been made since the new model was first announced. There has, however, been a gradual stepping up and while no definite announcement has been made it is generally believed that this will continue until the huge resources of the company are in full use.

Employment in the immediate industrial district here is increasing at the rate of from 4,000 to 5,000 a week. This week's increase was slightly less than last week's, but was above the 4,000 mark.

CINCINNATI

Reports of machine tool manufacturers in the Cincinnati district indicate that while the general market was sluggish in the past week, the machine tool industry of the section, taking it as a whole, did a little better than to hold its own.

One manufacturer reported that his plant was "very busy" and another that his plant was "tolerably busy." But these are exceptional cases, the majority stating that there was no great activity in production in the period.

Selling agents report that in the past week the market in their respective territories was dull and they did little better than to keep sales at the level of the previous week.

Both branches of the trade, however, with very few exceptions, express optimism and the great majority predict a substantial increase in the demand in the near future.

The great majority of the orders booked in the past week came from miscellaneous users and general machinists and called for single tools and replacements. These buyers were well distributed over the different sections of the country and their purchases were well diversified in the matters of sizes and types. Several orders for single tools are reported as having been received from automobile manufacturers and concerns in the allied industries.

Manufacturers and selling agents report the receipt of an increased number of inquiries in the past week, the great majority of which came from miscellaneous users and general machinists in all sections of the country and being devoted to single tools and replacements.

SOUTHERN DISTRICT

From conversations with business executives, industrialists and economists with public utilities, it appears that business conditions in the Southern States are distinctly on the upward trend. One economist, of a large utility stated "there is, in my opinion, not an essentially adverse economic factor on the horizon as far as the South is concerned."

It is true, the fall months and through the first two weeks of December apparently witnessed conditions which created a rather pessimistic outlook among business in general, but the holiday sales, and the impetus witnessed in general business and industry since the opening of the year have swept this cloud entirely away. 1928 should be a good year in the South, though the year will probably not witness anything resembling a so-called "business boom."

Announcement has been made by Daniel Upthegrove, president of the St. Louis Southwestern Railway, that $95,000 will be spent for machinery for the Tyler shops this year. This is taken to mean that a larger force will be employed there during 1928. The Cotton Belt pay roll out of Tyler annually is estimated at more than $2,000,000. Early in January Upthegrove announced that $1,900,000 would be spent on the track between Mount Pleasant and Tyler and $1,000,000 on the right of way between Dallas and Sulphur Springs.

Buyers and Sellers Hold Novel Exhibit at Bridgeport Meeting

EIGHTY-FIVE manufacturers of machine shop supplies, from various parts of the country exhibited at the Co-operative Exhibit held under the direction of the Salesmen and Purchasing Agents Association, Inc., at the Mosque, Bridgeport, Conn., on Feb. 24 and 25. In addition there was an overflow of exhibits in the lobby of the Stratfield Hotel. The exhibit is stated to be an entirely new venture, and is for the purpose of bringing together buyer and seller for a better understanding of each other. It had the active co-operation of the Manufacturers Association of Bridgeport, the local Chamber of Commerce, and the Employment Managers' Association. More than 25,000 tickets had been distributed on request before the opening of the show.

The exhibit included materials and supplies usually purchased in the New England and Eastern New York districts, but few machines were displayed. It is not intended to hold the exposition annually, nor to confine it to the Connecticut district. It is believed that the idea will be extended, and similar shows held in other cities as occasion arises. The present exhibit was in charge of R. T. Phipps, Purchasing Agent of the Bullard Machine Tool Company. The exhibitors included the following firms:

Aluminum Co. of America, American Hardware Co., American Pulley Co., American Swiss File & Tool Co., American Saw & Manufacturing Co., Apothecaries Hall Co., Atlantic Manufacturing Co.

Bay State Tap & Die Co., Bader Adamson Co., Bridgeport Airport, Inc., The Bassick Co., Bunting Brass & Bronze Co., Bridgeport Brass Co., Black & Decker Manufacturing Co., Brown & Sharpe Manufacturing Co., Berry Bros., Bussman Manufacturing Co., Bryant Electric Co., Chas. Bond Co.

Crane Co. Chisholm Moore Manufacturing Co., Cutting & Woods, Cann & Saul Steel Co., Cornwall & Patterson Co., Colts Patent Fire Arms Co., Crouse-Hinds Co., Chromium Corporation of America, DeMattia Wire Works, Danbury Square Box Co., T. L. Dickenson Co.

Economy Fuse Manufacturing Co., H. M. Ellsworth Co., Erie Malleable Iron Co., Edison Lamp Works, Excelsior Plimttruck Co., Frank H. Fargo Co., J. B. Ford Co., Graybar Electric Co., Inc., General Box Co., General Electric Co., Hanson-Van Winkle-Munning Co., Herman Behr & Co., Inc., Heppenstall Forge Co.

Hartford Belting Co., Hilo Varnish Co., Hunter & Havens, Hawley Hardware Co., Hessel Hoppen Co., Johns-Mansville Co., Knott-Garllum, Ludlum Steel Co., Lindquist Hardware Co., Mass Walstein Co., MacDermid, Inc., Manning Abrasive Co., F. W. McLanathan & Son, Norman T. Moore Lumber Co., Midvale Steel Co., Norton Co., J. W. Paxson-Taggart Co.

Pittsburgh Plate Glass Co., Precision Grinding Wheel Co., Inc., Quigley Furnace Specialty Co., Ridge Tool Co., J. H. Richardson, Inc., Southern New England Electric Co., Seymour Manufacturing Co., Standard Oil Co., Skinner Chuck Co., F. B. Stevens, Inc., S. K. F. Industries, Standard Tool Co.

Simplex Tool Co., Trumbull Electric Manufacturing Co., Unishear Co., Inc., Vanadium Alloy Steel Co., Westinghouse Electric & Manufacturing Co., Wellington Kincaid Co., Warren Belt Co., Walker Rachliff Co., J. H. Williams & Co., Yale & Towne Manufacturing Co., Zapon Co.

G.E. Pension Plan

A contributory pension plan, whereby employees pay in a small part of their wages from year to year to a pension fund, supplementing the old age pension system which the General Electric Co. has had in effect since 1912, has been announced by Gerard Swope, president of the company. At the same time Mr. Swope announced the creation of a pension trust. $5,000,000 has been turned over to the trustee of the new trust by the company.

Business Items

Sundstrom Steel Co., 8030 S. Chicago avenue, Chicago, has been incorporated, to manufacture and deal in tools, dies, parts, machines, etc. Capital $50,000.

Letters of incorporation have been issued to Marking Products Co., 106-24 North Jefferson Street, Chicago. The company will operate a general foundry and machine shop business.

The Shepard Elevator Co., 2425 Colerain Ave., Cincinnati, Ohio, manufacturer of ball-bearing electric elevators, announces the recent opening of a branch office to handle the company's trade in the southeastern territory, at 317 Farnsworth Bldg., Memphis, Tenn.

Announcement is made that the Boston Gear Works Sales Co. with Main Offices and Factories at Norfolk Downs, Mass., has taken over the exclusive distribution of Duckworth Industrial Chains in the United States, with the exception of the Pacific coast territory.

The Rice Manufacturing & Distributing Co., Inc., Laurel, Miss., according to a recent announcement by R. L. Rice, Sr., Gulfport, Miss., president of the company, has leased a building at Laurel and purchased machinery and equipment to be immediately installed for the manufacture of a safety automatic automobile light control.

The Central of Georgia Railroad Co. announced recently the placing of orders for steel cars amounting to nearly $1,000,000, and for 15,000 tons of new rails for its needs during 1928, the latter order amounting to about $650,000, both orders being placed with the Tennessee Coal, Iron & Railroad Co., Birmingham, Ala.

BLACK & DECKER MANUFACTURING CO., has made three recent appointments in its personnel and assigned them to these respective fields: R. C. Bastress, formerly with the Fort Wayne Iron Store Co., Indiana and part of Michigan; L. W. Beuhausen, formerly with Slocum & Kilburn, Western Pennsylvania; and G. N. McCarthy transferred to the Chicago field.

General Machinery and Heating Supplies, Ltd., has been formed in Vancouver, British Columbia. The concern is the outcome of a merger of Western Heating and Ventilating Supplies, Ltd., and Robert G. Sweatt, Ltd. The company will deal in boilers and radiators, heating and ventilating supplies for all types of building, power plant equipment of every description, and mining machinery.

The American Car & Foundry Motors Co., Detroit, Mich., has established a parts distributing branch and service department in Atlanta, Ga., at 1109 Peachtree St. N. E., to handle the company's trade in the group of southeastern states, according to a recent announcement by Fred Koenig, 5718 Russell St., Detroit, manager of the company's service department. L. C. Gracey is in charge of the Atlanta branch.

The plant, machinery and stock of the Canadian Radiant Electric Co., located at Grimsby, Ontario, have been purchased by Allan Campbell, and his associates, of Bowmanville, Ontario. The plant is being dismantled and will be shipped to Bowmanville at once. Arrangements have been made whereby the Bowmanville Foundry Co. will install the machinery in its plant for doing the heavy stamping, casting and plating operations.

Tonnage of pig iron produced in Canada during 1927, amounting to 709,697 long tons, was 7 per cent lower than in the previous year, but the output of steel showed considerable improvement at 907,638 tons, as compared with 776,888 tons in 1926. The gain in steel production was due mainly to the increase in tonnage required for rails and other railway equipment and to a better demand from the construction, machinery and agricultural implements industries.

Dayton Pneumatic Tool Corp., Dayton, Ohio, has succeeded the Dayton Pneumatic Tool Co. The announcement points out that reorganization was effected to provide larger sales and service facilities and to manufacture a new line of tools, in addition to the pneumatic riveting hammers, chipping hammers, sand hammers, nail drivers and similar products now produced. L. B. George is president and treasurer, G. C. George, vice-president and H. P. Williamson, secretary.

The Eaton Axle and Spring Company will buy and retire all the outstanding 6 per cent preferred stock of its wholly-owned subsidiary, the Eaton Spring Corporation, at an early date, it has been announced, leaving the latter company with a capitalization solely of 10,000 shares of no par common stock, all of which is owned by the parent company. The Eaton Axle and Spring Co. will issue $750,000 five-year 5½ per cent gold notes, which will be used, together with other funds, for the retirement of the subsidiary's preferred stock.

The annual report of the Massey-Harris Co., Ltd., indicated that sales during 1927 were the largest in the history of the company, showing an increase of 17½ per cent, and exceeding those of 1920, the previous record year, by $728,115. Each of the twelve Canadian branches experienced an improved volume of business, the individual increases ranging from 4 to 65 per cent. Sales outside of Canada showed an improvement of 12 per cent, each overseas branch having exceeded its previous year's record. The business abroad continued to be much better than the domestic trade, representing 65 per cent of the whole. The relative proportions, however, were somewhat less than in 1926.

Personals

T. A. KILGOUR, formerly vice-president of the H. W. Petrie Machinery Co., Toronto, and associated with that firm for many years, has joined the T. B. Reid Machinery Co., Toronto.

E. O. JOHNSTONE, district sales manager for the American Chain Co., Inc., 425 Second St., San Francisco, has been appointed Pacific Coast distributor of Ford chain hoists to the industrial trade.

C. H. KATHE, purchasing agent and traffic manager of the Hill Clutch Machine & Foundry Co., Cleveland, Ohio, has resigned. He had been associated with the company for nineteen years; sixteen years as traffic manager and purchasing agent.

EDWARD J. P. FISHER, research metallurgist for the Diamond Chain and Manufacturing Company, Indianapolis, which will be the instructor for the course of ten weekly lectures on "The Metallography of Steel" will be given by the Indianapolis chapter of the American Society for Steel Treating starting Feb. 29. The theoretical, engineering and production angles of the subject will be presented during the course.

E. W. RICE, JR., honorary chairman of the board of directors of the General Electric Co., has been named a member of the American Committee of the World Congress of Engineers to be held in Tokio, Japan, in November, 1929. Sharing this honor with Mr. Rice are three other members of the company: Gerard Swope, president; C. C. Chesney, vice-president, and Professor Elihu Thomson, director of the Thomson Research Laboratory of that concern. The appointments were made by Secretary of Commerce Herbert Hoover.

Obituaries

ALBERT C. LUDLUM, president of the New York Engineering Co., 75 West Street, is dead. In 1889 he joined the Kennedy & Pierce Co., of Denver, Colo., makers of mining machinery. In 1895 he joined the firm of James Beggs & Co., New York, as engineer and sales manager and remained until 1906, when he organized the New York Engineering Co., manufacturers of gold dredging equipment.

W. E. B. PARTRIDGE, formerly superintendent of the foundry and director of the Union Tool Co. of Los Angeles, died suddenly from heart failure at his home in Redondo Beach, Calif., Feb. 9. He formerly was connected with the Truro Foundry and Machine Co. in Truro, in that province. In 1886 he moved to Los Angeles, Cal., and became connected with the Baker Iron Works, and in 1899 organized the Partridge and Alford Iron Works, which was later incorporated as the American Engineering and Foundry Co., with Mr. Partridge as president. In 1908 this was merged with the Union Tool Co.

ANTHONY L. HERKENHOFF, general manager of the Minster Machine Co., Minster, Ohio, and for 30 years prominent in the machinery industry of this country, died suddenly of an acute heart attack on Tuesday, Feb. 21, at Sidney, Ohio, while on a business mission. He was born at Minster, Ohio, in 1872 and attended St. Mary's Institute at Dayton, Ohio. After being employed at the Atlas Engine Co. in Indianapolis for a number of years, he was instrumental in the organization of the Minster Machine Co. in Dayton in 1896, serving as its general manager from that time until his death. In 1916 he, with some of his business associates, organized the St. Marys Foundry Co., at St. Marys, Ohio, and served as vice-president and general manager since its inception. In 1918 the Streine Tool & Manufacturing Co., of Bremen, Ohio, was similarily organized and he served as the president of that company from the time of its organization.

Calendar of Local Meetings

National Association of Cost Accountants

Baltimore Chapter. April 17. Subject: "The Budget in Manufacturing—Application of Budgetary Principles and Their Performance."

Boston Chapter. April 26. Subject: "Cost and General Accounting Procedure for a Paper Mill," by Homer A. Sargent.

Buffalo Chapter. April 26. Hotel Buffalo. Subject: "Debatable Questions in Industrial Accounting." By Clarence S. Marsh.

Cincinnati Chapter. April 17. Subject: "Accounting for Value of Fixed Assets," by H. G. Baldwin.

Chicago Chapter. April 19. Subject: "What the Sales Department Wants From the Accountant," by V. Frank Banta.

Forthcoming Meetings

National Safety Council. Mid-West Safety Conference, Chicago, March 19. A. A. Mowbray, director of publicity, 108 E. Ohio St., Chicago.

American Gear Manufacturers' Association. Twelfth annual meeting, Rochester, N. Y., April 19, 20 and 21, Hotel Seneca. T. W. Owen, secretary, 3608 Euclid Ave., Cleveland, Ohio.

American Welding Society. Annual meeting, week of April 23, New York City. M. M. Kelly, secretary, 33 West 39th Street, New York City.

American Railway Association. Schedule of sectional meetings: Division IV, Engineering, March 6 to 8, Chicago; Division V, Mechanical, June 13 to 20, Atlantic City, N. J.; Division VI, Purchases and Stores, June 13 to 15, Atlantic City, N. J.

National Metal Trades Association. Thirtieth annual meeting, Hotel Astor, New York, April 25 and 26. J. E. Nyham, secretary, Peoples Gas Bldg., Chicago, Ill.

National Foreign Trade Council. Fifteenth anniversary convention, Houston, Texas, April 25, 26 and 27. O. K. Davis, secretary, India House, Hanover Square, New York.

American Foundrymen's Association. Convention and Exhibit, Philadelphia, May 14 to 18. Technical Sessions at Hotel Belleview-Stratford; exhibit at Commercial Museum. R. E. Kennedy, secretary, 140 So. Dearborn St., Chicago.

National Association of Purchasing Agents. Annual meeting and "Informashow," Kansas City, Mo., May 28 to 31. W. L. Chandler, secretary, 11 Park Place, New York.

Association of Iron and Steel Electrical Engineers. Annual meeting, Stevens Hotel, Chicago, June 25 to 29. J. F. Kelly, managing director, Empire Bldg., Pittsburgh, Pa.

American Society for Testing Materials. Annual meeting, Chalfonte-Haddon Hall, Atlantic City, N. J., June 25 to 29. C. L. Warwick, secretary, 1315 Spruce St., Philadelphia, Pa.

Society of Automotive Engineers. 1928 Summer Meeting, Chateau Frontenac, Quebec, Canada, June 26 to 29. C. E. Heywood, in charge of meetings, 29 West 39th St., New York.

American Railway Tool Foremen's Association. Annual meeting, Hotel Sherman, Chicago, Sept. 12, 13 and 14. G. G. Macina, secretary, 11402 Calumet Ave., Chicago.

American Railway Tool Foreman's Association. Sixteenth annual convention of the Supply Association, Hotel Sherman, Chicago, Sept. 12, 13 and 14. F. A. Armstrong, secretary, the Pratt & Whitney Co., 564 W. Monroe St., Chicago.

American Society for Steel Treating. "National Metals Exposition," Commercial Museum, Philadelphia, Pa., week of Oct. 8. W. H. Eisenman, secretary, 4600 Prospect Ave., Cleveland, Ohio.

The Weekly Price Guide

Rise and Fall of the Market

STEEL shapes and plates rose 5c. per 100 lb. to $1.90, in carloads, f.o.b. Pittsburgh, during the last week. Small lots sell at $2 per 100 lb. f.o.b. mill. This makes the third rise in structural steel since November, 1927, at which time the price was $1.75 base, Pittsburgh. The steel industry, generally, is operating at 85 per cent of capacity, against 83 per cent in January and 66 per cent during December, 1926. Steel sheets remain firm at January levels, while tendency to move upward is noted in cold finished bars and track bolts. The price trend in non-ferrous metals continues downward.

(All prices as of Feb. 24)

IRON AND STEEL

PIG IRON—Per gross ton, f.o.b.:

CINCINNATI	
No. 2 Southern	$21.44
Northern Basic	20.89
Southern Ohio No. 2	21.19
NEW YORK—Tidewater Delivery	
Southern No. 2 (silicon 2.25@2.75)	25.62
BIRMINGHAM	
No. 2 Foundry	16.00
PHILADELPHIA	
Eastern Pa., No. 2x (silicon 2.25@2.75)	21.76
Virginia No. 2	27.17
Basic	21.26
CHICAGO	
No. 2 Foundry local (silicon 1.75@2.25)	20.00
No. 2 Foundry, Southern (silicon 2.25@2.75)	22.80
PITTSBURGH, including freight charge ($1.76) from Valley	
No. 2 Foundry	20.26
Basic	19.26
Bessemer	21.26

IRON MACHINERY CASTINGS—Cost in cents per lb. of 100 flywheels, 6-in. face x 24-in. dia., hub not cored, good quality gray iron, weight 275 lb.:

Detroit	4.50@4.75
Cleveland	5.00
Cincinnati	4.30
New York	5.25
Chicago	4.50@4.75

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the mill base in large lots.

Blue Annealed	Pittsburgh Mill Base	Chicago	Cleveland	New York
No. 10	2.10@2.20	3.50	3.25	3.89
No. 12	2.15@2.25	3.55	3.30	3.94
No. 14	2.20@2.30	3.60	3.35	3.99
No. 16	2.30@2.40	3.70	3.45	4.09
Black				
Nos. 18 to 20	2.70@2.80	3.75	3.55	4.00
No. 22	2.85@2.95	3.90	3.70	4.15
No. 24	2.90@3.00	3.95	3.75	4.20
No. 26	3.00@3.10	4.05	3.85	4.30
No. 28	3.15@3.35	4.20	4.00	4.45
Galvanized				
No. 10	2.95@3.05	4.10	3.90	4.25
Nos. 12 to 14	3.05@3.15	4.20	4.00	4.35
No. 16	3.15@3.25	4.30	4.10	4.45
No. 18	3.30@3.40	4.45	4.25	4.60
No. 20	3.45@3.55	4.60	4.45	4.75
No. 22	3.50@3.60	4.65	4.50	4.80
No. 24	3.65@3.75	4.80	4.60	4.95
No. 26	3.90@4.00	5.05	4.85	5.20
No. 28	4.15@4.25	5.30	5.10	5.45

WELDED STEEL PIPE—Warehouse discounts are as follows:

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv.
1 to 3 in. steel butt welded	53%	39%	55½%	43½%	54%	41%
2½ to 6 in. steel lap welded	48%	35%	53½%	40½%	51%	38%

Malleable fittings: Classes B and C, banded, from New York stock sell at list plus 4% less 5%. Cast iron, standard, sizes 36–5% off.

Size, Inches	List Price per Foot	Diameter in Inches—External	Diameter in Inches—Internal	Thickness Inches
1	$0.17	1.315	1.049	.133
1¼	.23	1.66	1.38	.14
1½	.27½	1.9	1.61	.145
2	.37	2.375	2.067	.154
2½	.58½	2.875	2.469	.203
3	.76½	3.5	3.068	.216
3½	.92	4.0	3.548	.226
4	1.09	4.5	4.026	.237
4½	1.27	5.0	4.506	.247
5	1.48	5.563	5.047	.258
6	1.92	6.625	6.065	.28

SEAMLESS STEEL TUBING—Following net prices are for seamless mechanical tubing, cold drawn, round, .10 to .30 carbon, at New York warehouse in lots of less than 100 ft. or 100 lb.:

Thickness—Decimal	B.w.g. and Fractions	Outside Diameter in Inches—⅛	¼	⅜	½	⅝	¾	1	1¼	1½
		Price per Foot								
.035"	20	$0.15	$0.16	$0.17	$0.18	$0.19	$0.21	$0.23		
.049"	18	.17	.18	.19	.20	.21	.23	.25		
.065"	16	.19	.20	.21	.22	.23	.25	.27		
.083"	14	.20	.22	.23	.24	.25	.27	.29		
.095"	13	.21	.23	.25	.26	.27	.29	.31		
.109"	12	.22	.24	.26	.27	.28	.30	.32		
.120" or										
.125"	11	.23	.25	.27	.28	.29	.31	.33		
.134"	10	.24	.26	.28	.29	.30	.32	.34		

MISCELLANEOUS—Warehouse base prices in cents per lb.:

	New York	Cleveland	Chicago
Spring steel, light*	4.50	....	4.65
Spring steel, heavier	4.00	....	4.00
Coppered Bessemer rods	6.05	6.00	6.20
Hoop steel	4.49	3.65	4.15
Cold rolled strip steel	6.25	5.70	6.10
Floor plates	5.25	5.30	5.00
Cold drawn, round and hex	3.40	3.65	3.60
Cold drawn, flats and squares	3.90	4.15	4.10
Structural shapes	3.34	3.00	3.10
Soft steel bars	3.24	3.00	3.00
Soft steel bar shapes	3.24	3.00	3.00
Soft steel bands	3.99	3.65	3.65
Tank plates	3.34	3.00	3.10
Bar iron (2.75 at mill)	3.24	3.00	3.00
Drill rod (from list)	60%	55%	50%

Electric welding wire, New York, 5/32, 8.35c.; ¼, 7.85c.; 5/32 to ½ 7.35c. per lb. *Flat, 3/16@¼-in. thick.

METALS

Current Warehouse Prices in Cents Per Pound for Small Lots.			
Copper, electrolytic, up to carlots, New York			15.37½
Tin, pigs, 5-ton lots, New York			54.50
Lead, pigs, up to carlots, E. St. Louis 6.02½		New York	7.50
Zinc, slabs, up to carlots, E. St. Louis 5.45		New York	7.00

	New York	Cleveland	Chicago
Antimony, slabs, ton spot	13.50	13.87½	14.25
Copper sheets, base	22.75	22.75	22.75
Copper wire, base	19.37½	19.37½	16.00-16.25*
Copper bars, base	22.25	22.25	22.25
Copper tubing, base	24.50	24.50	24.50
Brass sheets, high, base	18.75	18.75	18.75
Brass tubing, high, base	23.62½	23.62½	23.62½
Brass rods, high, base	16.50	16.50	16.50
Brass wire, high, base	19.25	19.50	19.25

*Mill.

Shop Materials and Supplies

METALS—Continued

	New York	Cleveland	Chicago
Aluminum ingots, 99%	27.00	26@27	24.03
Zinc sheets (casks)	11.00	12.65	10.36
Solder (½ and ½), (case lots)	33.50	35.50	33@37
Babbitt metal, delivered, New York, cents per lb.:			
Genuine, highest grade			69.00
Commercial genuine, intermediate grade			60.00
Anti-friction metal, general service			31.50
No. 4 babbitt (f.o.b.)			12.25
Nickel, f.o.b. refinery, cents per lb.:			
Ingots 35.00	Electrolytic 37.00	Shot 36.00	

SPECIAL NICKEL AND ALLOYS—Price in cents per lb., f.o.b. Huntington, W. Va.:

Full finished nickel sheet (base)	52.00
Cold rolled nickel sheet (base)	60.00
Hot rolled rods, Grade "A" (base)	45.00
Cold drawn rods, Grade "A" (base)	53.00

Base price of Monel metal in cents per lb., f.o.b. Huntington, W. Va.:

Shot	28.00	Hot rolled rods (base)	35.00
Blocks	28.00	Cold drawn rods (base)	43.00
Cold rolled sheets (base)	50.00	Full finished sheets (base)	42.00

OLD METALS—Dealers' purchasing prices in cents per pound:

	New York	Cleveland	Chicago
Crucible copper	12.25 @12.50	11.50	11.00@11.50
Copper, heavy, and wire	11.50 @12.25	10.75	10.50@11.00
Copper, light, and bottoms	10.25 @10.75	9.50	9.25@ 9.75
Heavy lead	5.00 @ 5.12½	5.25	4.50@ 5.00
Tea lead	4.00 @ 4.12½	3.75	3.50@ 4.00
Brass, heavy, yellow	7.12½@ 7.37½	7.25	7.00@ 7.50
Brass, heavy, red	9.00 @ 9.50	9.75	9.00@ 9.25
Brass, light	5.50 @ 6.00	5.75	6.00@ 6.50
No. 1 yellow rod turnings	7.25 @ 7.75	7.50	7.00@ 7.50
Zinc	3.25 @ 3.50	3.25	2.50@ 3.00

TIN PLATES—Charcoal—Bright—Per box.

		New York	Cleveland	Chicago
"AAA" Grade:				
IC,	14x20	$12.10	$11.95	$11.50
"A" Grade:				
IC,	14x20	9.70	9.90	9.50
	Coke Plates—Primes—Per box			
100-lb.,	14x20	6.10	6.10	7.00
	Terne Plates—Small lots, 8-lb. Coating—Per box			
IC,	14x20	7.75@8.00	7.00	7.50

MISCELLANEOUS

	New York	Cleveland	Chicago
Cotton waste, white, per lb.	$0.10@0.13½	$0.16	$0.15@0.20
Cotton waste, colored, per lb.	.09@ .13	.12	.12@.17
Wiping cloths, washed white, per lb	.17@.17½	38.00 per M	.15
Sal soda, per lb.	.02	.02	.02¾
Roll sulphur, per lb	.027	.03½	.04
Linseed oil, raw, per 7½-lb. gal., 5 bbl. lots	.76½	.86	.78
Lard cutting oil, 25% lard, in 5 gal. cans, per gal.	.65	.50	.50
Machine oil, medium-bodied (55 gal. steel bbl.) per gal.	.27	.35	.26
Belting—Present discounts from list in fair quantities (½ doz. rolls).			
Leather—List price, 24c. per lin.ft. per inch of width for single ply.			
Medium grade	35%	35%	35%
Heavy grade	30%	30%	30%
Rubber transmission, 6-in., 6 ply, $1.83 per lin.ft.			
First grade	45%	50–10%	50%*
Second grade	50%	60–5%	50–10%†

*Large quantities, 60%. †Large quantities, 60–10%.

Comparative Warehouse Prices

New York	Unit	Current Price	Four Weeks Ago	One Year Ago
Soft steel bars	per lb.	$0.0324	$0.0324	$0.0324
Cold drawn shafting	per lb.	.033	.033	.04
Brass rods	per lb	.165	.165	.1562½
Solder (½ and ½)	per lb	.335	.35	.4212½
Cotton waste, white	per lb.	.10@.13½	.10@.13½	.13@.17½
Emery disks, cloth, No. 1, 6-in. dia	per 100	3.10	3.10	3.10
Lard cutting oil	per gal.	.65	.65	.55
Machine oil	per gal.	.27	.27	.33
Belting, leather, medium	off list	35%	35%	40–5%
Machine bolts, up to 1x30 in., full kegs	off list	50%*	50%*	40%

*New list April 1, 1927.

MISCELLANEOUS—Continued

	New York	Cleveland	Chicago
Abrasive materials—Standard grade, in sheets 9x11 in., No. 1, per ream of 480 sheets:			
*Flint paper	$5.40	$4.95	$5.13
*Emery paper	10.71	9.15	10.71
*Emery cloth	27.84	27.85	27.84
Emery disks, 6 in. dia., No. 1, per 100:			
Paper	1.29	1.27	1.32
Cloth	3.10	3.05	3.05
Fire clay, per 100 lb. bag	1.00	.75	.75
Coke, prompt furnace, per net ton	Connellsville, 2.65@3.00		
Coke, prompt foundry, per net ton	Connellsville, 3.75@4.50		
White lead, dry or in oil	100 lb. kegs	New York, 13.75	
Red lead, dry	100 lb. kegs	New York, 13.75	
Red lead, in oil	100 lb. kegs	New York, 15.25	

*4½ reams and under.

SHOP SUPPLIES

Discounts from new list dated Apr. 1, 1927, applying on immediate deliveries from warehouse stocks in New York and vicinity:

	Full Kegs or Cases
Machine bolts, square heads and nuts:	
Up to ¾ x 6-in.	55%
Larger up to 1 x 30-in.	50%
1⅛ and 1¼ in. dia.	35%
Carriage bolts:	
Up to ½ x 6-in.	55%
Larger sizes	50%
Coach and lag screws:	
Up to ½ x 6-in.	55%
Larger sizes	50%
Tap bolts, hexagonal heads	40%
Nuts:	
Hot pressed, square and hexagonal, blank or tapped, up to 1-in., incl.	55%
Cold punched, square and hexagonal, blank or tapped, up to 1-in. incl	55%
Semi-finished, hexagonal, tapped, in packages, all sizes	40%
Case hardened, hexagonal, tapped, in packages, all sizes	30%
Washers: Deduct from list, per 100 lb	$3.50*
Rivets, button and cone head:	
Small, including 7/16-in. dia	50–10%
Large (base) per 100 lb. net	$5.00†

Note—For less than case or keg quantities on bolts, screws, hot-pressed and cold-punched nuts, add extra of 10 per cent to list.
*Broken keg lots, $1.50 off list. †Broken keg lots, $6.50 net.

Machine Requirements and Industrial Construction

Equipment Wanted

D. C., Washington—Bureau of Supplies & Accounts, Navy Dept., will receive bids until Mar. 6 for one metal workers engine lathe, motor driven at Chelsea, Mass., also until Mar. 13 for drills and grinders.

Mass., New Bedford — R. W. Powers, Broad St., Providence, R. I.—miscellaneous tools and equipment for proposed repair and service garage at Kempton and Summer Sts., here. Estimated cost $40,000.

Mich., Bay City — Chevrolet Motor Car Co., Flint—equipment for handling and assembling parts for proposed 1 story, 225 x 900 ft. automobile factory at North Madison St., here. Estimated cost $450,000.

Mich., Detroit—Gairing Tool Co., 19 West Woodbridge St.—one grinder for universal use.

Mich., Detroit—F. J. Lamb Co., 6343 Wight St. (toolmakers)—drill press and boring mill.

Mich., Detroit—F. L. Jacobs Co., 6901 East Lafayette Ave. (tubes) press and equipment.

Mo., St. Louis—Buck's Stove Range Co., 3500 North Second St.—Swaine double crank geared press, No. 73.

N. J., East Orange—Bd. of Water Comrs., R. M. Roper, Secy.—will receive bids until Mar. 8 for a 2 ton crane and mono-rail equipment at Midland Ave. yard.

R. I., Providence—R. I. Motor Mart Inc., Union St.—miscellaneous tools and equipment for proposed 1 story, 105 x 200 ft. garage. Estimated cost $100,000.

N. Z., Wellington—New Zealand Government Railways, will receive bids until June 25 for four battery shunting locomotives and charging sets, two boring mills for car and waggon tires, one vertical boring mill for wheel centers, one face grinding machine, four plain milling machines, two sand cutting machines, two screening and mixing machines, two pattern makers sanding machines, four pipe and tube bending machines, one sheaving machine, four universal type spot welding machines, two heavy duty suspension type spot welding machines, one Standard type spot welding machine, two paint spraying machines, thirteen electric rivit heaters, four circular saw benches, three oil fired spring furnaces, four automatic melting sets, seven a.c. arc welding sets, etc.

Opportunities for Future Business

Calif., Los Angeles—Club Aluminum Co., Inc., 1250 Fullerton Ave., Chicago, Ill., A. R. Hamm, 1238 South Hill St., Local Branch Mgr., plans the construction of a factory here. Estimated cost $250,000. Architect not selected.

Calif., Oakland — E. C. Anthony, 2111 Webster St., awarded contract for a 3 story garage and service building at Harrison St. and Bay Pl. Estimated cost $200,250.

Calif., Oakland—Bd. of Education, will soon award contract for a 1 and 2 story shop, etc. for Lakeview Junior High School. Estimated cost $150,000.

Calif., San Francisco—Judson Pacific Co., E. A. Wilkins, Mgr., consolidated with Pacific Rolling Mill Co. and Judson Mfg. Co., 609 Mission St., is having preliminary plans prepared for an iron works plant on Missouri, 17th, 16th and Mississippi Sts.

Del., Wilmington — National Lumber & Creosoting Co., 312 Railway Exchange Bldg., Kansas City, Mo., plans the construction of first unit of plant capable of handling 6,000 cars of lumber a year on 50 acre site here.

Ga., Tallapoosa—Georgia Steel & Iron Co., plans the construction of a plant. Estimated cost $100,000.

Ill., Chicago—Mineralac Co., 25 North Peoria St., manufacturers of electrical supplies, awarded contract for a 2 story, 72 x 115 ft. factory at 25-29 North Peoria St. Estimated cost $30,000.

Ill., Chicago — Reflector & Hardware Specialty Mfg. Co., 2235 South Western Ave., awarded contract for a 1 story, 92 x 129 ft. factory at 2243-53 South Western Ave. Estimated cost $75,000.

Ind., South Bend—Bendix Brake Co., 401 Bendix Dr., awarded contract for a 1 story, 100 x 120 ft. factory. Estimated cost $40,000.

Ind., South Bend — McCaffery Co., awarded contract for a 2 story, 55 x 166 ft plant. Estimated cost $46,000.

Ia., Griswold—Lace Oil Gas Burner Co., c/o L. A. Cocklin, Pres., is having preliminary plans prepared for two 1 story 72 x 150 ft. buildings for oil gas burner plant.

Ky., Louisville — Henry Vogt Machine Co., 1000 West Ormsby St., will build a 2 story factory and machine shop at 10th and Ormsby Sts. Estimated cost $40,000.

Mass., Boston—Boyiston St. Land Co., c/o E. B. Stratton, 25 Arch St., Archt., awarded contract for a 1 story, 30 x 110 ft. repair and service garage. Estimated cost $40,000. Noted Feb. 2.

Mass., Chicopee—Municipal Light Board, is receiving new bids for 3 story, 60 x 70 ft. garage and repair shop on Front St. Estimated cost $85,000. H. J. Tessier, 1132 Main St., Springfield, Archt. Noted Mar. 24, 1927. Former bids rejected.

Mass., East Boston (Boston P. O.)—Gibby Foundry Co., Condor St., Boston, plans reconstruction of plant recently destroyed by fire here. Estimated cost $50,000. Architect not selected.

Mass., Lynn—Essex Tire & Supply Co., 118 Central Ave., is having revised plans prepared for a 2 story, 60 x 100 ft. shop. Estimated cost $40,000. G. A. Cornet, 10 Central Ave., Archt. Noted Feb. 16. Former bids rejected.

Mass., New Bedford—Dept. of City Property, City Hall, is receiving bids for a vocational school including machine and electric shops, etc. C. Hammon & Son, 179 North Water St., Archts.

Mass., Somerville (Boston P. O.)—P. J. Kiley, 101 Washington St., is receiving bids for a 1 story, 95 x 95 ft. auto body shop. Private plans.

Mass., Wareham—Emile St. Jaques, Main St., will build a machine shop. Private plans. Noted Nov. 24.

Mich., Detroit — Smith, Hinchman & Grylls, 800 Marquette Bldg., Archts., are receiving bids for a 2 story, 75 x 130 ft. factory on East Jefferson St., for Superior Seal & Stamp Co., 151 East Jefferson Ave. Estimated cost $70,000.

Minn., Minneapolis—C. W. Olson Mfg. Co., manufacturers of structural steel, ornamental iron, fire escapes, etc. will soon receive bids for a 1 story plant, recently destroyed by fire at 1300 Quincy St. N. E. Private plans.

Neb., Omaha—General Outdoor Advertising Co., 3823 Leavenworth St., awarded contract for a 1 story, 55 x 100 ft. garage and repair shop. Private plans.

Neb., Omaha—Paxton-Mitchell Co., J. L. Paxton, Pres., is having plans prepared for a 1 and 2 story, 100 x 414 ft. iron foundry at 27th and Martha Sts. Estimated cost $200,000. Austin Co., 16112 Euclid Ave., Cleveland, O., Engrs.

N. J., Bloomfield — Consolidated Safety Pin Co., 46 Farrand St., awarded contract for a 3 story, 35 x 75 ft. factory. Estimated cost $40,000. Noted Jan. 12.

N. J., Paterson—Cowega Realty Co., L. Gottlieb, Pres., East 27th St., is having revised plans prepared for a 2 story, 215 x 250 ft. garage on Ellison Pl. Estimated cost $250,000. A. E. Sleight, Romaine Bldg., Archt. Former bids rejected. Noted Feb. 16.

N. J., West New York—N. Buchiarelli, 231 17th St., is having plans prepared for a 2 story, 40 x 100 ft. woodworking shop at Hudson Ave. between 16th and 17th Sts. Estimated cost $40,000.

N. Y., Brooklyn — B. & M. Cleaners & Dyers Inc., 428 Stone Ave., will receive bids about Mar. 5 for a 1 and 2 story garage, etc., at 106-118 New Lots Rd. Estimated cost $40,000. R. Shulkind, 147 4th Ave., New York, Archt.

N. Y., Brooklyn—New York Dock Co., 44 Whitehall St., New York, had plans prepared for a 12 story, 345 x 373 ft. factory and storage building at Furman and Joralemon Sts. here. Estimated cost $2,218,000. R. G. Cory, 30 Church St., New York, Archt.

N. Y., Brooklyn—Progressive Table Co. Inc., M. Perloff, Pres., 273 Newport St., had plans prepared for a 2 story, 95 x 103 ft. factory at Ditmas Ave. and East 95th St. Estimated cost $50,000. Kessler & Goldsmith, 4914 Church Ave., Archts.

O., Bryan—Vail Cooperage Co., plans to rebuild 1 story factory recently destroyed by fire. Estimated cost $40,000.

O., Cincinnati—Ninth St. Garage Co., 34 West 6th St., awarded contract for an 8 story garage at 9th and Walnut Sts. Estimated cost $1,000,000.

O., Cincinnati—Sycamore Garage, 2400 Gilbert Ave., will soon receive bids for a 4 story garage. Estimated cost $300,000. H. Hake, 2400 Gilbert Ave., Archt.

O. Cleveland—Packard Motor Car Co., 1580 East Grand Blvd. Detroit Mich., awarded contract for a 2 story, 115 x 320 ft. auto sales and service building at East 93rd St. and Carnegie Ave. here. Estimated cost $400,000.

O., Elyria—Steel & Tubes Inc., H. B. Wick, Pres., 224 East 131st St., Cleveland, plans the construction of a hot strip mill here. Estimated cost $1,500,000. Private plans.

O., Grenfield—Gray Elliott Furniture Mfg. Co., plans to rebuild 2 story factory recently destroyed by fire. Estimated cost $40,000.

Okla., Guthrie — Atchison, Topeka & Santa Fe Ry., 80 East Jackson Blvd., Chicago, Ill., is having plans prepared for a 1 story, 80 x 140 ft. machine shop here. Estimated cost $50,000. H. W. Wagner, Topeka, Kan., Engr. (Eastern Lines).

Ore., Portland—Portland Van & Storage Co. 199 East Broadway, c/o Clausen & Clausen, McLeary Bldg. awarded contract for a 2 story, 60 x 95 ft. warehouse and repair shop. Estimated cost $40,000.

Pa., Pittsburgh—Packard Motor Car Co., 4709 Baum Blvd., awarded contract for a 135 x 192 ft. sales and service building. Estimated cost $150,000.

Tenn., Memphis—Service Motor Car Co., will soon award contract for a 1 story, 198 x 210 ft. machine shop at South Dudley St. and Eastmoreland Ave. Estimated cost $100,000. Hanker & Cairns, Hill Bldg., Archts.

Va., Hampton Roads—Bureau of Yards & Docks, Navy Department, Washington, D. C., will receive bids until Mar. 21 for the construction of hangar and shop for Naval Operating Base (Air Station) here.

Ont., Oshawa—Superior Window Contracting Co., plans the construction of a factory. Estimated cost $30,000.

Que., Outremont — Bell Telephone Ltd., 118 Notre Dame St. We., Montreal, plans the construction of a 6 story garage on Hutchison St. here. Estimated cost $350,000.